THE
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THE BRITISH ASSOCIATION MEETING.

WHILST the meetings of the British Association for the Advancement of Science nowadays are of far less direct importance to the electrical industry than they were in the days when that industry was finding its feet and was receiving invaluable aid from the papers and discussions and from the work of the B.A. Committees, their proceedings usually contain a great deal of interest to electrical engineers, especially on the physical side of the art, which is intimately bound up with almost every branch of science. Special emphasis is conferred upon this close connection by the fact that the President on this occasion is Professor Sir Ernest Rutherford, F.R.S., a physicist who has won world-wide fame by his investigations into the electrical structure of matter—the subject which he has chosen for his address. It is interesting to recall that a former president of the Association—Sir William Crookes—who as long ago as 1878 studied the flying corpuscles of the "cathode rays" and described them as "matter in a fourth state," dealt with the subject in its embryonic stage in his presidential address at Bristol, 25 years ago; in the same year Madame Curie brought to a climax her epoch-making discovery of radium, the key that unlocked the gate of a vast field for research the existence of which had only been vaguely surmised up to that time.

As Sir Ernest points out in his address, of which an abstract appears elsewhere in this issue, never before in the history of physics has there been such a period of intense activity as during the last quarter of a century, which has witnessed a continuous succession of brilliant discoveries, bringing us ever nearer to the solution of the problem of the constitution of matter. Yet, curiously, although we are now able to declare with almost dogmatic assurance that all matter is electricity, we are still unable to answer the age-old question: "*What is electricity?*" By researches of which the brilliancy and resourcefulness are excelled only by the superhuman processes of deductive reasoning that the investigators have brought to bear upon the results of their observations, the ultramicroscopic atom has been dissected and analysed, and its constituents have been identified as of but two kinds—positive and negative particles of electricity; of the latter, thanks very largely to the genius of the President, we know a great deal—though it may well be that there remains a vastly greater deal yet to learn—but of the former we know comparatively little. The fundamental unit of electric charge, indivisible and eternal (so far as we know) is that of the electron or negative particle, and it has been measured to an accuracy of one part in a thousand, although the mass of the electron is less by 1,840 times than that of the particle of matter of the smallest mass known to us—the hydrogen atom. But the positive particle, if there be such, eludes detection; it is never met with alone, and as Sir Ernest says, not the slightest evidence has been found even of the existence of a positive particle like the electron. In fact, he concludes that the positively charged hydrogen atom, or "nucleus," *is itself*

the atom of positive electricity. Apparently its greater mass, contrasted with that of the electron, is to be attributed to its greater concentration—"the greater mass of the hydrogen nucleus would be accounted for if its size were much smaller than that of the electron"—a seeming paradox, which, however, is in accordance with electrical theory.

Thus we arrive at the view that all matter is built up of these two electrical units, negative and positive respectively—the electron and the hydrogen nucleus or proton—but we are still left wondering *what* is electricity?

Automatic Sub-stations.

The use of automatically-controlled plant in sub-stations is advancing rapidly in the United States, and we give elsewhere in this issue particulars of a motor-generator set of no less than 3,750 kW, which has been ordered for this purpose. The controlling apparatus has been worked out so that the plant will apparently do its own thinking, and meet every emergency with the correct manœuvre. The thought suggests itself, however, that when one is dealing with such large outputs it may be found advisable to put a skilled man in charge of the automatic mechanism; and if that be the case, why install the mechanism? When the capital charges alone on a sub-station amount to some thousands of pounds per annum, the saving effected by the adoption of automatic control, after allowing for the extra charges on the latter, the cost of its maintenance, and the cost of supervision, may be hardly worth the trouble. We do not lay stress on the question of reliability; whilst it is true that the greatest forethought in design and the most painstaking supervision cannot render automatic electrical apparatus immune from occasional failure, it is equally certain that the human factor is liable to error or derangement, and that neither system can avert the consequences of such a mishap as the incineration of a too-venturesome rat, or a mechanical breakdown due to some hidden flaw. On the score of reliability, it may be that there is not much to choose between automatic and manual operation; but unless a material economy is assured, it seems a mistake to expend the extra capital.

In the case of small sub-stations, in which the cost of skilled supervision is relatively much greater, there are strong arguments in favour of automatic control, and it is being adopted by several supply undertakings in this country.

Whitley Councils.

The electricity supply industry may be considered as having committed itself finally to the principles of Whitleyism. Despite a certain amount of criticism and recalcitrant action on the part of a few undertakings here and there, the Whitley system has certainly worked efficiently in this industry during the past four years' trial. But it is interesting to glimpse a wider view as to the progress of Whitleyism generally amongst other industries. The report on the establishment and progress of Joint Industrial Councils issued by the Ministry of Labour, and covering the period 1917 to 1922, gives us a bird's-eye view of this kind. The report rehearses the reports of the Whitley Committee and the successive steps which led up to the formation of the Councils, and it then proceeds generally to survey the individual work of the various Councils. The record, on the whole, is a conclusive testimony to the wisdom of the Whitley system. The Whitley Reports were issued in 1917, and the first Joint Industrial Council was established in January, 1918. This Council was for the pottery industry, and was followed in a few months by a Whitley Council for the building industry. Among public utilities a Council for waterworks and gas respectively was formed in April, 1919, and for electricity supply in the next month, the tramways following in September of the same year. Altogether between 1918 and 1921, 73 Joint Industrial Councils were constituted. Added to these there were 33 interim Industrial Reconstruction Committees established (which are a kind of Whitley Council adapted for industries which are not fully organised industrially). Certain of these, however, have ceased to function, and certain others have been reconstituted as Joint Industrial Councils. The system was further developed by 150 District Councils being formed and over 1,000 Works Committees, the whole of the foregoing system embracing about 3 million workers. Of the 73 Joint Industrial Councils, 15 are not at present functioning, although a certain number of the subordinate District Councils still continue to act in industries where the national body has ceased work.

The report does not give any total as regards meetings except that during 1920, 1921 and 1922 there were 800 meetings of Joint Industrial Councils. To these have to be added the meetings of the 150 District Councils, which even if they met at about the same intervals would mean another 2,000 meetings, and to these again have to be added all meetings before 1920.

It will be seen, therefore, that the total number of meetings runs to a high figure, which speaks for itself as to the widespread operations of the Whitley system. These meetings, besides carrying out the immediate practical business, namely, that of dealing with standardising wages, settling sliding scale adjustments, working conditions, and so forth, must also have helped to carry out the ideal of the Whitley Councils, namely, that of securing "a permanent improvement in the relations between employers and workmen." The report draws attention to the fact that the Whitley Committee held the view "that a permanent improvement in the relation between employers and employed must be founded upon something other than a cash basis," and there is no doubt that the regular meetings between the two sides as above indicated has incidentally helped to a much more adequate understanding, and developed a wholly new spirit of mutual goodwill. So far as the electricity supply industry is concerned, this certainly has been the case, to judge by testimony from all sides.

The electricity supply industry may certainly be proud of the results achieved under its Whitley Council and of the solidly constitutional procedure with which all questions relating to labour are now settled throughout the industry. Further, it may not be too much to say that this complete industrial organisation which has taken place under Whitleyism has contributed in however modest a degree to the present undoubted prosperity of the industry.

Tramway Economies.

Since the war, the necessity of practising every possible economy has forced itself upon the attention of all tramway managers, and the subject has come under discussion repeatedly at annual conferences; individual managers have adopted various measures with a view to improving the ratio of working expenses to receipts, but until a few weeks ago no mention had been made, so far as we know, of the possibility of making material economies by slightly modifying the wiring of the cars.

In our issue of July 13th, 1923, p. 50, we inserted a communication from Mr. J. Austen Baker, in which he briefly summarised the results of certain experiments; we are now pleased to afford Mr. Baker the opportunity of setting forth the circumstances in greater detail, in our later pages. We understand that for many months the methods which he describes have been adopted on eight tramcars with resulting economies and other advantages which are well worthy of the consideration of tramway managers—more especially because they are obtained at a trifling cost. The reasons for the improvement which Mr. Baker and his colleagues have observed appear somewhat obscure, and might well be the subject of further investigation.

JAPANESE AFFAIRS.

Although the reports regarding the terrible disaster that recently befell the Japanese Empire are still incomplete, it is satisfactory to learn that the loss of life and the damage to property were both considerably less than it was feared they would be when the first information was received. Nevertheless, the appalling nature of the calamity could not fail to call forth sympathy from all parts of this and other countries where the progressive enterprise of the Japanese people has been closely followed. We tender, on behalf of the Electrical Review, and, indeed, we are sure we can say on behalf of the whole electrical profession and industry of the British Empire, the most sincere feelings for a people who have been so suddenly afflicted. As we do so, however, we remember the stoical and determined character of the Japanese, and, doing so, are confident that there will be no want of courage, determination, and resource in meeting the great difficulties that the earthquakes and holocaust have brought upon them. Large numbers of British business houses have shown their sympathy in practical fashion by subscribing to the relief funds, and in the lists of these so far published, large electrical and engineering companies, who have branches in Japan or are in close trading relations with her people, have figured prominently. It has been most pleasing to note in the daily lists of the "Safe," the names of representatives of many of these companies. We congratulate both the men and women personally and the companies with which they are engaged.

Official information received in London early this week confirms that great material damage was done by fire in Tokio. The districts most severely affected by the earthquake are Numadzu, Ito, Chiba, and the towns of Yokohama, Yokosuka and Odawara have suffered the greatest amount of damage, 80 per cent. of the houses in all three places having been destroyed by fire. Railway traffic has been completely restored, except on a portion of the Tokaido line, but a few more days are still necessary to complete the repairs to the telephone system. The chief centres of business in Tokio and Yokohama have been completely destroyed. The buildings of a number of the banks remain intact, and the payment of small sums, not exceeding the limit set by the moratorium, has taken place since the 8th inst. In spite, therefore, of the magnitude of the loss sustained, the economic condition of the country will, it is hoped, be restored speedily to a normal state. The Bourses at Osaka and other centres are shortly resuming operations, which will doubtless tend to allay public anxiety, as general trading and economic operation will be carried out at Osaka and Kobe.

The actual effect of the disaster on electrical works is not yet known in this country, but from such information as is available it appears that many days did not elapse before electrical service was resumed in parts of Tokio, and electric tramways and railways in the suburbs were in operation, but electrical engineers and installation staffs will have a great deal to do with the reconstruction operations in the worst affected areas. The Tokio Electric Light Co., Ltd. (Tokyo Dento Kabushiki Kaisha), which in June last placed a three-million pound issue of bonds in this country, has its property and operations scattered over a very extensive area beside Tokio and Yokohama, and the major portion of its generating capacity is far removed from the scene of the disaster and remains intact. The recovery of the new securities of this vast concern from the first effects on their Stock Exchange quotation is not therefore, a matter for surprise. From the particulars which were published in our issue of June 29th it will be recalled that the issued capital was nearly 26 million pounds sterling, and that the new issue of bonds (£3,000,000) was for providing the necessary sum to repay indebtedness to bankers and others and for the general extension of the plant. The company has over 21,000 shareholders, and has paid a dividend every year of its 37 years' existence.

It serves an area of nearly 9,375 square miles, extending from the Pacific Coast to the Sea of Japan, which includes a population of nearly 9,100,000, of which the city of Greater Tokio has an area of 215 square miles, with a population of 3,358,000. The Prefecture of Tokio and eleven other prefectures, including the cities of Yokohama, Yokosuka, Mayebashi, Takasaki, Kiriu, Ashikaga, Shidzuoka, &c., and other towns and villages scattered in 42 districts are supplied by the company with its own power and also that of the associated companies. The company owns generating stations with equipment for producing 278,960 kW, and has under construction new plant of a capacity of a further 99,000 kW; of this total—377,960 kW—312,530 kW is hydraulic, and 65,430 kW steam. It derives an additional supply from associated or sister companies amounting to 48,500 kW, and has the prospect of obtaining a further 112,900 kW from those companies, as they also are constructing new plant.

While referring to the Tokio Company, we may quote as the latest report to hand a cable received early in the week by the Whitehall Trust from its agents in Japan. It reads as follows:—

"*Tokio Electric Light—While company sustained severe loss stability unaffected. Main sources power supply intact. Service in Tokio partly resumed. Rapid progress for complete reinstatement.*"

An Osaka report quotes the Minister of Finance as saying that it was possible that Japan would find it necessary to seek a loan abroad for reconstruction.

Japan has during the last decade made vast extensions to her works for the production of electrical and other manufactures, and has built up a considerable export trade. It is difficult to believe that the present disastrous state of affairs will materially affect her operations in such directions, unless quite temporarily; indeed, according to Wednesday's City Comments in *The Times*, the Finance Minister states that "as the damaged zone does not cover those districts which produce goods for export or any of the other principal products of the country, it is firmly believed that the effects of the disaster upon the commercial and industrial condition of Japan will not be great."

From observations made before the disaster, and therefore quite independent of it, it was held by His Majesty's Commercial Counsellor that the Japanese market was one of great promise. How much assistance from outside will be called for, under the altered circumstances, cannot yet be foretold. Japanese electrical men have at their command a great capacity which will enable them to deal with the large volume of work arising from the earthquakes, but possibly they will require a certain measure of co-operation from their *confrères* in other countries, including the United Kingdom. But, speaking generally, it may be stated that in these days of tumbling marks, fluctuating francs, and depreciated South American exchange rates it is refreshing to hear of a country where exchange shows no great fluctuations, taxation is moderate, unemployment is slight, and labour troubles are few. According to the report to the Department of Overseas Trade made by the Commercial Counsellor and the Commercial Secretary at Tokio, all these favourable conditions are found in Japan. The position there, it is said, is perfectly sound, and, compared with most countries in the world, trade is flourishing, or was so before recent disastrous events. It may be asked whether due account has been taken of the set-back that Japanese export business has suffered, owing largely to high costs of production and to the fact that her great export staple, silk, is threatened with severe competition by an artificial substitute. As a matter of fact, the optimistic statements expressed by the Department's Overseas officers are made with due regard to all factors. It is

expected that the adverse balance of trade will be reduced as a result of the officially-inspired policy which is directing the exchange banks to restrict import credits for transactions regarded as unnecessary to the economic life of the country. Official and unofficial efforts have also been made to encourage national economy, although it is admitted without much success, up to the present.

There is some reason to hope that in its tariff policy the Japanese Government will keep steadily in view the need to reduce the general costs of production, and therefore the cost of living. This tendency is of special interest to the British engineering industry, because the Japanese makers of machinery have been urging an increase in the import duties, and it is not considered likely that any increase will be sanctioned.

Sir Edward Crowe, the Commercial Counsellor, echoes the criticism that is often heard about the comparatively small amount of money spent by British exporters in their selling campaigns. Japan is now an expensive country to live in, and the steamship fare is high; but, says the report, unless manufacturers are prepared to incur this expense, they must not be surprised if the business goes elsewhere. It is added that they might do a great deal more advertising, and also follow the example of United States firms by sending more experts —particularly in engineering—to look for business. The report is reviewed below.

In a review of the possibilities of the present situation, appearing in the *Financial Times*, it was stated on the 6th inst. that the vast extent of the devastation gave rise to much discussion as to what measures would have to be taken by Japan to restore the shattered economic fabric. The general view was that a large reconstruction loan would have to be raised, and this possibility was spoken of sympathetically. In Government and financial circles in Washington, says the Exchange Telegraph, it is anticipated that important economic consequences affecting the United States and other nations may arise from the destruction of property in Japan. This undoubtedly must seriously affect commercial relations with Japan throughout the world, and it is predicted that Japan will be obliged to seek large credits abroad.

The commercial condition of Japan up to June last is reviewed by the Commercial Counsellor and Commercial Secretary at Tokio in a report that has just been issued by the Department of Overseas Trade.

A cheerful view of the country's general economic condition is taken in the report. "Perfectly sound" is the description applied to the general position. Japan is not like the impoverished countries of Europe, with a depreciated currency and unstable government. The absence of any considerable fluctuations in the exchange is a feature that should surely appeal to the British merchants and exporters who have been harassed in their operations ever since the Armistice by the oscillations of the Continental and South American currencies.

It must not be overlooked that Japan needs export trade. She is at present too greatly dependent upon her sales of silk abroad, mainly in the United States, her shipping trade in cottons and certain other articles having fallen off, due not only to depressed conditions in her principal markets, but also to high prices. Reference is made to this situation in the Commercial Counsellor's report. "Wages remain high," it says, "and overhead charges are disproportionate to industrial requirements. These two factors, combined with relatively low efficiency, militate against an active export trade, which is Japan's most urgent need."

United States Competition.

In commenting on the fact that the share of the United Kingdom in the import trade of Japan is only 12 per cent., the report says that the great need is the dispatch to Japan at frequent intervals of experts, particularly in regard to engineering. The Americans have realised this fact. Whereas prior to 1911 the imports into Japan from the United Kingdom were always greater than those from the United States, now they are much less than half. It is not surprising to learn that there are at the present moment many American experts in Japan, all looking for business, and in most cases obtaining it.

In an instructive tabular statement the report shows the values of the imports of machinery into Japan for about three years. It will be seen that the American share is gradually being reduced, while the largest gains have been made by Germany:—

IMPORTS OF MACHINERY.

	1921. 1,000 yen.	1921. 1,000 yen.	1922. 1,000 yen.	Jan. Mar. 1923. 1,000 yen.
United States	73,536	63,612	57,310	14,186
United Kingdom ...	31,564	43,983	42,203	11,547
Germany	688	5,892	7,891	2,876
Other countries	4,783	6,395	6,967	2,282
Total	110,571	119,882	114,371	30,891

Textile machinery accounts for one-third of the total, and the United Kingdom is largely represented therein. The Americans, however, claim a very big share of the electrical trade.

In connection with the demand for construction materials, the opinion is expressed in the report that British firms should now be able to obtain more of the business in steel which, since the war, has largely gone to the United States. The Americans, it is said, have also captured the cream of the trade in steam-heating apparatus, strong rooms, mail chutes, &c. As an example of the adoption of modern methods in Japan, it is mentioned that whereas before the war there were probably not more than a dozen passenger lifts in the whole Japanese Empire, it is now estimated that over 200 are installed annually. There is a Japanese company in Osaka manufacturing both passenger and goods lifts.

Refrigerating machinery and accessories are likely to be needed in order to provide cold storage facilities for meat and fish. With a view to reducing the cost of living the Government is credited with the intention of encouraging the importation of Canadian and Australian meat. So keen is the movement to cheapen food that the Prefectural authorities have been importing frogs.

Railway Electrification.

The Government' declared policy of strict financial retrenchment on all State affairs was not extended to the State railways, and it has been decided not only to carry out the already established ten years' scheme, but also to undertake the construction of new lines in order to develop the local traffic. The new lines approved by the last session of the Imperial Japanese Diet number 28, the total mileage of which will be 840 miles, and the total construction expenses Y676,236,000. Work is to be started this year on some of these lines and next year on the remainder, all to be completed by 1933. In addition to the above the Diet has approved a further sum of Y814,379,400 as a continuing expenditure for improvements to be undertaken from the fiscal year 1923-1924 till 1931-1932. The most important of these improvements is the scheme for the electrification of the Tokaido line. According to the announcement made by the Department of Railways, the work will start at Akashi, near Kobe, some time this year and will be completed by 1928, the total expenditure for the work being estimated at Y21,983,000. The electrification of the Tokio-Odawara and Ofuna-Yokosuka lines, work on which has already been begun, is to be completed by the end of the present fiscal year, and that of the Odawara-Numaru section by the end of the fiscal year 1926-1927. Other improvements deserving of mention are (1) the doubling of the track between Kobe and Shimonoseki (Sanyo Line) making the use of large locomotives possible and thus reducing the journey by express from Tokio to Shimonoseki by more than an hour; and (2) the improvement of the Shimonoseki-Fusan ferry service, with the result that the crossing which formerly took eleven hours has been reduced to about nine hours.

The construction of the subway railway system between Moji and Shimonoseki, which was begun last year, will not be completed until 1931, due to a change in the plan of construction. The total expenses for the work are estimated at Y29,230,000 instead of Y18,000,000.

In Kobe, which is in most respects the most progressive port in Japan, a system has been introduced by which wireless telephone apparatus can be installed on a vessel immediately after her arrivel in port. This means that direct communication can be maintained with ordinary telephone subscribers in the city of Kobe.

With regard to the much-discussed hydro-electric scheme at Lake Candidus, Formosa, H.M. Consul at Tamsui reports that arrangements have been made whereby a cash advance of Y5,000,000 is to be made from the finance department of the Central Government to the Taiwan Denryoku Co., to enable the latter to recommence work on this scheme, which has been in a state of suspended animation since the summer of 1922. Interest will be paid by the company on this advance at the rate of 6 per cent. only, whereas bonds floated in the open market would cost them, including bankers' commission and expenses, over 9 per cent.

The company hoped to start work again about the month of June, 1923. The date of completion cannot be predicted with any certainty, but the work is likely to take at least two years. The original plans have been cut down, and the whole project will be on a more modest scale than was originally contemplated.

TRAMCAR ELECTRICAL EQUIPMENTS.

By J. AUSTEN BAKER, A.M.I.Mech.E., A.M.I.E.E.

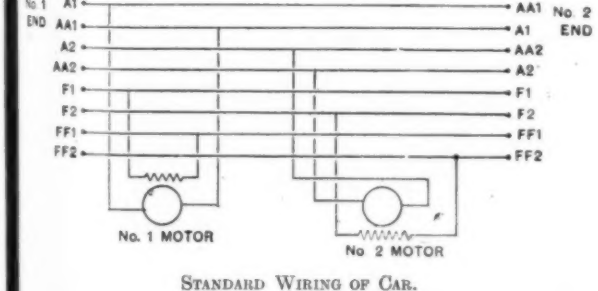
The possibility of effecting very considerable economies in the operation of tramcars has resulted from a series of experiments which were recently undertaken. Amongst tramway men it is well known that a tramcar exhibits the characteristics of two entirely different vehicles, one set of characteristics being observable on the outward journey, whilst the running of the car on the return trip is entirely and almost inexplicably different.

To explain why a car runs more efficiently in one direction, whilst exhibiting an entirely different operation on the return trip, is a matter of difficulty, for it must be remembered that an electric tramcar is a symmetrical vehicle, fitted with motors giving similar results on the works test sheets; whilst the control gear at each end is interchangeable; furthermore, a car put on the weighing machine gives a result such that the axle weights are approximately identical.

To follow more closely the variations of running a tramcar in either direction, it is to be understood that both motors are running in series, then one of the two motors is momentarily short-circuited during the period when the transition is made from the series to the parallel combination.

The ends of a tramcar are designated respectively No. 1 and No. 2 end, so that there is a No. 1 controller and a No. 1 motor at one end of a car, whilst the motor and controller at the other end of the car are numbered 2 for convenience and identification; thus if a car is travelling in a direction A such that No. 1 controller is being used, the current path on the series notches is to the leading No. 1 motor, thence to the rear No. 2 motor and to earth, and if the car is travelling in the reverse direction B, and No. 2 controller is being used, the current path is to No. 1 motor in the rear, thence to No. 2 motor in front and to earth.

When a tramcar is travelling towards A, and No. 1 controller is being used, the leading No. 1 motor begins to slip, and if the rail is greasy, or a start from a dead stop is made on a curve or a gradient, the excessive wheel slip on the axle driven by the leading No. 1 motor is



Standard Wiring of Car.

such that the car makes little headway. Sand is needed to assist adhesion, and the acceleration of the car is slow and jerky.

On the other hand, if the same tramcar is travelling in the opposite direction B, and No. 2 controller is being used, No. 1 motor is in the rear. There is no wheel slip, acceleration is smooth and uniform, and adhesion is quite good without the aid of sand.

Those well known characteristics of a car were tried out over a route nine miles in length from the centre of a city to a suburban terminus, the route in question being of double track. Full day cars running with No. 1 motor in the rear were able to do the journey in from four to seven minutes quicker than schedule time, and they showed a reduction in energy consumption of one B.O.T. unit per journey as compared with the cars running with No. 1 motor at the leading end of the car —this series of tests was very exhaustively carried out and confirmed the well-established opinion of motormen that a car drives much better from No. 2 end; *i.e.*, with No. 1 motor in the rear.

Further investigation elicited the very interesting fact that motor-men, when taking a car out of the depôt, will invariably turn the car so that No. 2 end is heading towards the difficult part of any route, and it was found on the system with which the writer is connected that on three hilly routes rising out of the city to a higher suburban area it was the practice of the regular drivers to run the cars with No. 2 end pointing to the outer termini, so that on the gradient No. 1 motor would always be in the rear.

This custom, coupled with the better timekeeping and reduced energy consumption, as described in an earlier paragraph, seemed to point out the advantage of so arranging the power circuit that the rear motor would always be No. 1 electrically, irrespective of the direction of operation, and thus attain the motor-man's ideal of a car with both ends No. 2 end, or, in other words, a car giving the good results in either direction which is now attained when a tramcar is being driven in the direction when No. 1 motor is in the rear.

It was therefore decided to make a change from the conventional system of car wiring, and the control and motor circuits of one tramcar were re-arranged, so that No. 1 controller was arranged for the current path to be to the rear—or No. 2 motor of the standard system—thence to the front motor, or No. 1 as usually designated, and to earth.

It will be remembered that No. 1 motor is in the rear when No. 2 controller is being used, so that no change was necessary in this portion of the motor circuit cabling and connections, the standard system of control at this end of the car being for the current to pass through No. —the rear motor, thence to No. 2—the leading motor and to earth.

Such success attended the running of this first experimental car that seven others were immediately altered and placed in full-day service, so that a general average set of figures could be got out; each of the eight cars was especially chosen in order that many types and makes of controllers and motors and various combinations of these could be tried out.

Since January last these cars have been running in competition with and under identical conditions with those arranged in the standard manner and the general results may be summarised as follows: Energy consumption shows a reduction of from 2 per cent. to 8 per cent., according to condition of rail and weather; sanding, whilst almost entirely eliminated, is considered as being reduced by 50 per cent.; the running time of the car per journey of nine miles is quicker by four to seven minutes, due to the good and smooth acceleration, whilst tire wear is increasing in mileage by roughly 2,000 miles on No. 1 end driving wheel, due entirely to the fact that there is no wheel slip and that consequently the abrasive action between wheel tread and rail, due to sanding, is for all practical purposes non-existent.

At the time these experiments were being tried out, two other troubles, not thought to have any relation to each other, were investigated; they were a serious jerk when the controller was being moved from "series" to "parallel," and the large number of No. 2 motor commutators sent into the repair shop for commutator truing.

The transition "jerk" is one which is noticed by any passenger, and to the tramway engineer it is a matter

of more than passing interest. A few journeys on a tramcar were sufficient to show that this jerk was only really noticeable when the car was running in one direction. Here, again, No. 1 end of the car, with No. 1 motor leading, was found to be at fault.

A car was run over a nine-mile route and stops were made eight times to the mile; furthermore, stops were made on the centre of each curve and at several points on rising gradients met with in the course of the journey. The first journey was run with No. 1 end leading, *i.e.*, No. 1 motor in front, and the second trip was made with No. 2 end leading and No. 1 motor in the rear of the car.

At the start of No. 1 run, when No. 1 motor was leading, the controller was placed on the first notch, the resistance value for this point being roughly 6.5 ohms. No. 1 motor began to slip and the instrument showed, as was expected, that the voltage across the terminals of No. 1 motor increased, and that the voltage across the terminals of No. 2 motor decreased, the power consumption being of a relatively low value; thus No. 1 motor was running light and at a high speed and No. 2 motor was found not to be exerting any tractive effort on the car at all.

The wheel slip was not corrected by throwing the controller to the "off" position, for the car was handled just as it would be by a motor-man over the second, third, and fourth notches. Wheel slip continued with constantly rising pressure on No. 1 motor until sand stopped the revolving No. 1 motor. Needless to say, the pressure across the two motors immediately equalised, but as No. 1 motor slipped again, very decided voltage fluctuations were observed on Nos. 1 and 2 motors. It must be remembered that schedules call for fast operation of the controller handle, and less than four seconds were required to move the handle from the "off" to the fourth series notch position.

At the time wheel slip was being observed, sand was in use, and the various fluctuations in both motors were being measured. The controller handle was moved by the driver from "series" to "parallel" in accordance with service conditions; the action on tramcar-type controllers being to short-circuit No. 2 motor, whilst No. 1 motor is being placed in parallel with the line, following which No. 2 motor is brought into "parallel." It will then be seen that No. 2 motor is momentarily "dead," and immediately placed across the line—less, of course, the small resistance loss of 1.5 ohms usually allowed on the fifth or first parallel notch, and at about five seconds from the start.

It will now be seen that No. 1 motor wheel slip cuts down tractive effort and acceleration, so that when No. 2 motor is placed in parallel with the line after the momentary "dead" period, the car is not travelling at the speed laid down as the series free running speed of the No. 2 motor—thus the galvanising into life of No. 2 motor places a very severe strain on the equipment, for it must be remembered that except under the best of conditions No. 2 motor is not doing its half share of propelling the car; it is momentarily "dead," and then placed on full load, less a slight ohmic value loss, therefore the throwing of No. 2 motor into parallel is recognised by the severe jolt which is transmitted to the car body at the moment when the fifth or first parallel notch connection is made by the motor-man.

On the second trial the car was driven from No. 2 end, with No. 1 motor in the rear. This run was made over the same route and under identical conditions, stops per mile, curves and gradients. The start from each stop was made without wheel slip, sand was not used, the voltages across both motors were similar and did not fluctuate, the acceleration was smooth and uniform, and the transition from series to parallel was made without jolt, jerk or strain. This again very conclusively proved the necessity for making the rear motor No. 1 electrically. The trials were made continuously and exhaustively carried out, so as to eliminate any error, the cars being of various single and double deck, four-wheel and bogie types.

By running cars continuously from No. 1 end, others from No. 2 end, and the experimental cars from both ends, it was soon seen that if the short-circuited No. 2 motor is in the rear of the car, the outward and visible sign of the jerk which follows the short-circuiting of the rear No. 2 motor—and, as previously explained, this must occur every alternate journey under normal conditions—is a gradually blackening commutator; ridges and flat spots follow, commutation loses its efficiency, electric braking becomes faulty, and brush wear becomes high—either a motor defect brings the motor into the repair shop or its state is so apparent to the shed staff that the armature is sent in to the repair depôt to have the commutator turned up to a true diameter.

Of several scores of commutators examined it is computed that something like $\frac{1}{8}$ in. of copper is turned off the No. 2 commutators every 50,000 to 75,000 miles; in addition there is the loss of revenue due to the car's being laid up, the cost of carrying out the eradication of this defect, whilst the wear and tear on bearings, pinions and gears, as well as the whole electrical equipment, makes out a stronger case in favour of arranging cars so that the rear motor is No. 1 electrically, whilst the short-circuited No. 2 motor is always at the front end of a car. The experimental cars arranged in this manner have never given any trouble and both commutators are as bright and as clean as could be desired.

Although the tramcar complete with body, cover, trucks and electrical equipment is a symmetrical vehicle, the reason for wheel slip at No. 1 end, whilst giving with the same motor good acceleration at No. 2 end, is not easy to state and the following reason is propounded. The motor at the leading end of the car at the start exerts a "lifting" and "pulling" action on the vehicle; the car body is a structure of an elastic nature owing to its being supported on springs, thus the tendency is for the car to hang back and settle the greater proportion of car weight over the rear axle or truck; conversely the front axle or truck is relieved of weight and due to the lower co-efficient of friction No. 1 motor begins to overrun itself; if, on the other hand, No. 1 motor is at the rear of the car, the impulse at starting is for the car body to be "lifted" and "pushed" or "wedged" along until the spring reaction is equal to the torque due to the inertia of the whole structure; in any case the elasticity of the car structure is such that the "lag" of the car imposes a greater weight on the rear end of the car, thus increasing the adhesion of the rear motor, a condition observable in the street.

It may be interesting to note that this re-connection of power wiring has been extended beyond the eight experimental cars, and it may be said that the acceleration of a four-motor equipment tramcar arranged with both rear motors in series with the two leading motors, is a revelation in power of acceleration, and no doubt an experiment on these lines with an electric train would yield some extremely interesting data.

A very noticeable happening during the experiments was the working of the overload circuit breakers and armature temperature rise. With No. 1 wheel slip and consequent high voltage, several controller faults occurred, following the heavy flash which took place as the series-parallel transition was being made, and no matter how fast the controller handle was being fed, the circuit breaker set for 200 amp. did not "blow"; nevertheless, at the end of a day the motor temperatures were very diverse. With No. 1 motor in the rear, both armatures gave a similar thermometer reading, and if the controller was being fed too quickly and the car was being pushed along or "flogged," as motor-men say, the circuit-breaker opened and thus acted as a safety valve on the equipment and as an automatic current-limiting device.

The experiments have conclusively proved that very large economies may be effected at a very small expense by arranging for the series power circuit to be to the rear motor, thence to the leading motor and to earth; further, the efficiency of the whole electrical equipment

can be considerably enhanced for the benefit of the user and rider.

The investigations were carried out to cure certain well-known defects, and it is hoped that the very simple remedy will commend itself to tramway engineers and managers and to those on the railways who are looking for means to effect economies and, at the same time, to increase the rate of acceleration with existing materials.

The writer has to thank his friends and colleagues, Messrs. Edwards and Etheridge, for their valuable help and advice during the past interesting months of research.

Cars:—

(1) 26 ft. 6 in. single truck (four-wheel), top-covered vestibule car; 6 ft. wheelbase.

(2) 34 ft. top-covered vestibule car; wheelbase 14 ft.

(3) 35 ft. 6 in. single-deck bogie car; wheelbase 16 ft.

Weights:—

Cars (1), 10 tons; (2), 14 tons; (3), 11 tons.

Motors:—

Dick, Kerr Co.'s 31.B, interpole, ventilated, 42 h.p.; B.T.H. Co.'s G.E. 200, ventilated, interpole, 35 h.p.; B.T.H. G.E. 58, totally-enclosed, non-interpole; Westinghouse Co.'s M. 200, 220 and 225, totally-enclosed motors. (All rated on 1 hour continuous running with temperature rise not more than 75 deg. above atmosphere.)

Controllers:—

Dick, Kerr D.B.1 form C. & K.; B.T.H. B.18 and B. 510; Westinghouse 90 and 90 M. Some had FF2 lead on motor case; others had all wires running back to controller.

Trolley Pressure:—

Approximately 500 volts; car circuit breakers set from 150 to 220 amps.

Route:—

Of nine miles, double track, steadily rising grade from city terminus to outer terminus; slight drop at suburban end.

THE BRITISH ASSOCIATION—I.

The ninety-first annual meeting of the British Association, and the fifth which has been held in Liverpool, commenced on Wednesday last, with the delivery of his address by the President, Sir Ernest Rutherford, D.Sc., LL.D., Ph.D., F.R.S.

Although chiefly concerned with more immediately practical affairs, or perhaps because of this, Liverpool is an excellent place for a meeting of this nature. Being so highly industrialised, it must acknowledge its indebtedness to science; and scientists on their part can congratulate themselves on the structure which has been erected as a result of their original researches. Liverpool is the second port of the country, and possesses about seven miles of docks, some of which are among the most extensively and efficiently equipped in the world. In addition to its shipping interests, however, the city is the home of many other important industries which support some 900,000 people (taking Bootle into consideration). The neighbouring towns of Birkenhead and Wallasey are of some importance, and altogether the area about Liverpool is one of the most important parts of the country commercially.

Upon the educational and cultural side, the city is very advanced, having an increasingly successful university, an excellent art gallery, and several libraries. The municipal enterprises are very successful. The electricity and tramway undertakings were dealt with at some length in our issue of December 15th, 1922 (p. 906).

The previous Liverpool meetings were held in 1837, 1854, 1870, and 1896. Several eminent men participated in the 1870 meeting, among them being Huxley (president), Tyndall, Rankine, and Lubbock. Sir Joseph Lister (Lord Lister) presided in 1896, and the programme included many important papers by well-known men in the youthful electrical industry. Prof. J. J. Thomson (now Sir J. J. Thomson) delivered the presidential address in Section A—Mathematics and Physics, and made reference to the then recent experiments of Prof. Röntgen. In the course of his remarks, Prof. Thomson also animadverted upon experiments which he had been carrying out with the assistance of Mr. Rutherford. In Section G—Engineering, Sir W. H. Preece read a paper on glow-lamp tests. Mr. Jagadis Chunder Bose described an instrument of his invention for the study of the properties of electric waves—reflection, refraction, absorption, interference, &c. A joint paper was presented by Lord Kelvin and Messrs. J. T. Bottomley and Magnus Maclean, dealing with the measurement of electric currents through air at different densities down to one five-millionth of the density of ordinary air. The Committee on Electrolysis asked for another grant, and promised a report for the next year's meeting. Mr. A. P. Trotter described a direct-reading Wheatstone bridge. The Electrical Standards Committee recommended the adoption of the joule as a unit of heat, with the "calory" as a secondary unit, and the work of another committee in connection with the standard screw gauge was presented to the meeting; this dealt principally with the care and use of the gauges.

Sir Ernest Rutherford, in his address, which is reproduced in abstract form, referred to this meeting, stating that his first scientific paper was read on this occasion. He recalled that in the discussion on his paper, which dealt with a new magnetic detector of electrical waves, the late Sir W. H. Preece told the meeting of the successful transmission of signals for a few hundred yards by electric waves which had been made by a young Italian, G. Marconi. From that time tremendous strides had been made, and a great part of the address was devoted to a review of the progress in physical science and its applications.

The address was broadcast simultaneously from the six British stations.

The new President is well-known to electrical men on account of his life-work in the investigation of the constitution of matter, the subject of his address. He delivered the 1922 Kelvin Lecture before the Institution of Electrical Engineers, and on that occasion we published a brief review of his activities (*vide* Elec. Rev., May 26th, 1922, p. 741).

The programme of the present Liverpool meeting is not so full of novel electrical matter as its predecessor in 1896, but nevertheless electricity inevitably enters largely into its composition. In Section A—Mathematical and Physical Science, on Thursday morning, two X-ray papers were read and discussed, "The Recent Work of Prof. A. H. Compton on the Scattering of X-Rays," by Prof. C. G. Darwin, F.R.S., and "X-Ray Absorption and the J Discontinuities," by Prof. C. G. Barkla, F.R.S. This morning (Friday) Sir Oliver Lodge was to read a paper on "Matter and Radiation." During the meeting, Mr. S. G. Brown will demonstrate the "Frenophone" or friction-operated loud speaker, which was shown at this year's Royal Society's *soirée*. Mr. W. M. Mordey is to give an experimental lecture upon alternating magnetism, in which study he has recently been engaged. "The Structure of Atoms and their Magnetic Properties" is the subject of a paper by Prof. Langevin, of the Sorbonne (Paris), and Prof. R. W. Wood and Dr. A. Ellett are to present a joint paper on "The Effects of Weak Magnetic Fields on the Polarisation of Resonance Radiation." The use of accelerated

anode rays in the determination of the constitution of the elements is to be dealt with by Dr. F. W. Aston, F.R.S. The question of atomic structure is receiving attention from another aspect in Section B—Chemistry. The discussion of this subject will be strengthened by contributions from Prof. Niels Bohr. In Section F—Economic Science and Statistics, the sectional President is to speak upon "Population and Unemployment," and other questions to be dealt with are post-war wages, the efficiency of workers, women's wages, transport, and housing, all of which have at least some interest for those engaged in the electrical industry. The first part of the programme of Section G—Engineering is mainly devoted to the discussion of transportation matters, and several men eminent in their particular branches of transport are to participate in the meetings. Other up-to-date matters which are being brought forward are electrical ship propulsion (Mr. F. H. Clough, C.B.E.), the conservation and control of water resources (Mr. J. Parry), and mercury arc rectifiers (Mr. R. L. Morrison). Many other important papers appear in the programme. Prof. E. W. Marchant is to speak upon the currents flowing between the earthed neutral of an alternator and the earthed sheath of the cable system, and (in conjunction with Mr. T. H. Turney) upon a method of improving the voltage wave shape of alternators by external means. Dr. T. F. Wall will describe a squirrel-cage induction motor with high starting torque and low starting current in the line. Mr. J. Scott-Taggart is again speaking on developments in radio-telegraphy and telephony, and Prof. W. M. Thornton is to deal with "The Mechanism of Gas Ignition" and "A Safe Method of Lighting Coal Mines." A number of interesting matters are included in the programme of Section J—Psychology, including vocational tests, fatigue, &c.

The meeting is a notable one for the number of foreign and Colonial visitors present. Professors Niels Bohr and Langevin have already been mentioned, and the discoverers of hafnium (Drs. Coster and Hevesy) are attending to describe their researches. Many scientists from Canada and the United States are among the visitors.

This year's innovations include the institution of five-o'clock lectures of a popular character for the benefit of workers just leaving factory and office. A scientific exhibition has been arranged by the Liverpool authorities, and a *soirée* on the lines of those of the Royal Society is to be held.

A large number of visits to works and places of interest have been arranged; the afternoons of those present will be fully occupied, for, in addition, there are many papers to be read late in the day.

The Electrical Structure of Matter.

Presidential Address by Prof. Sir ERNEST RUTHERFORD, D.Sc., LL.D., Ph.D., F.R.S. (*Abstract*).

"The first part of the address recalled the proceedings at the last Liverpool meeting in 1896, when X-rays and the transmission of electrical waves had only recently been discovered. The former had proved invaluable as an agent in attacking some of the fundamental problems of physics, while the latter had been considerably advanced by the application of the results of fundamental researches on the properties of electrons, in the form of the thermionic valve. This was but one example of the reaction between pure and applied science to the mutual benefit of both.

For some time after the formulation of the atomic theory by Dalton, the vaguest ideas were held as to the possible structure of atoms, but there was a general belief among the more philosophically minded that the atoms of the elements could not be regarded as simple unconnected units. The ideas on the subject were clarified by the proof, in 1897, of the independent existence of the electron as a mobile electrified unit, and it was soon seen that the electron must be a constituent of all the atoms of matter, and that optical spectra had their origin in their vibrations. Sir J. J. Thomson's work on the subject led him to the belief that the atom must be an electrical structure held together by electrical forces, and showed, in a general way, lines of possible explanation of the variation of physical and chemical properties of the elements, exemplified in the periodic law.

The whole conception of the atom and the magnitude of the forces which held it together was revolutionised by the study of radio-activity. It was soon shown that the atoms of radio-active matter were undergoing spontaneous transformation, and that the characteristic radiations emitted, *viz.*, α, β, and γ rays, were an accompaniment and consequence of these atomic explosions. These explosions involved energies which were gigantic compared with those involved in any ordinary physical or chemical process. In the majority of cases an α particle was expelled at high speed, but in others a swift electron was ejected, often accompanied by a γ ray, which was a very penetrating X-ray of high frequency. The use of α particles as projectiles with which to explore the interior of the atom had definitely exhibited its nuclear structure, had led to artificial disintegration of certain light atoms, and promised to yield more information as to the actual structure of the nucleus itself. The energy associated with a single α particle was so great that it could readily be detected by a variety of methods, including the zinc sulphide screen used by Sir William Crookes, and the system of suddenly cooling a moisture-saturated gas which showed the track of the particle, evolved by Mr. C. T. R. Wilson.

It was early surmised that electricity was atomic in nature and this view was confirmed and extended by a study of the charges carried by electrons, α particles, and the ions produced in gases by X-rays and rays from radio-active matter. It was first shown by Townsend that the positive or negative charge carried by an ion in gases was invariably equal to the charge carried by the hydrogen ion in the electrolysis of water, which was correctly assumed by Johnstone Stoney to be the fundamental unit of charge. The best method of measuring this charge was that devised by Millikan which depended on comparing the pull of an electric field on a charged droplet of oil or mercury with the weight of the drop. This gave a measure of the unit with an accuracy of possibly one in a thousand.

If the atom was an electrical structure it could only contain an integral number of charged units, and, since it was ordinarily neutral, the number of units of positive charge must equal the number of negative. There was a striking difference in mass between the electron and nucleus. All scientific men were convinced that the small mass of the negative electron was to be associated entirely with the energy of its electrical structure, so that the electron might be regarded as a disembodied atom of negative electricity. It was known that an electron in motion, in addition to possessing an electric field, also generated a magnetic field around it, and energy in the electromagnetic form was stored in the medium and moved with it. This gave the electron an apparent or electrical mass, which, while nearly constant for slow speeds, increased rapidly as its velocity approached the speed of light. Electrical theory showed that the mass of a given charge of electricity increased with the concentration, and the greater mass of the hydrogen nucleus would be accounted for if its size were much smaller than that of the electron. Such a conclusion was supported by evidence obtained from the study of the close collisions between α particles and hydrogen nuclei. It was found that the hydrogen nucleus must be of radius less than the electron, which is usually supposed to be about 10^{-13} cm.; also the experimental evidence was not inconsistent with the view that the hydrogen nucleus might actually be much smaller than the electron. There was the strongest evidence that the atoms of matter were built up of these two electrical units, *viz.*, the electron and the hydrogen nucleus, or proton. It was probable that these two were the fundamental and indivisible units which built up the universe, but it was possible that these units were complex, and divisible into even more fundamental entities. At the same time, it was to be borne in mind that the actual mass of an atom might be somewhat less than the sum of the masses of component positive and negative electrons when in the free state.

The modern conception of the nuclear atom arose from the experiments upon the deviation of α particles passing through the atoms of matter. It was found that occasionally a swift α particle was deflected from its rectilinear path through more than a right angle by an encounter with a single atom. In these atomic collisions there was no question of mechanical impact; the reaction between the two particles occurred through the intermediary of the powerful electric fields which surrounded them. The deflections showed that very intense deflecting forces existed inside the atom, and it seemed clear that electric fields of the required magnitude could be obtained only if the main charge of the atom were concentrated in a minute nucleus. A study of the scattering of α particles at different angles, by Geiger and Marsden, showed that the intense electric forces near the nucleus varied according to the law of inverse squares, and the experiments also allowed the fixing of an upper limit for the dimensions of the nucleus. All the atoms were found to show this nuclear structure, and an approximate estimate was made of the nuclear charge of different atoms. It was obvious that the number of units of resultant positive charge in the nucleus fixed the number of the outer planetary electrons in the neutral atom. In addition, since these electrons were in some way held in equilibrium by the attractive forces from the nucleus, and since it appeared that all atoms of one element were identical in their external structure, it was clear that their arrangement and motion must be governed entirely by the magnitude of the nuclear charge.

Data obtained from the scattering of α particles, and also

from the scattering of X-rays by light elements indicated that the nuclear charge of an element was numerically equal to about half the atomic weight in terms of hydrogen. It was fairly clear from general evidence that the hydrogen nucleus had a charge one, and the helium nucleus (the α particle) a charge two. Mosely, whose work had been verified by Chadwick, concluded from experiment upon the X-ray spectra emitted by a number of elements that the atomic number of an element was a measure of its nuclear charge. A relation of unexpected simplicity was thus found to hold between the elements.

The first definite attack upon the problem of the electronic structure of the atom was made by Niels Bohr, who applied the quantum theory developed by Planck to the structure of the hydrogen atom. He supposed that the single electron could move in a number of stable orbits, controlled by the attractive force of the nucleus, without losing energy by radiation. The position and character of these orbits were defined by certain quantum relations depending on one or more whole numbers. It was assumed that radiation was only emitted when the electron was transferred from one stable orbit to another of lower energy. In such a case it was supposed that a homogeneous radiation was emitted of frequency ν determined by the quantum relation $E = h\nu$ where E was the difference of the energy of the electron in the two orbits, and h the universal constant. The displacement of electrons had given rise to a novel theory of the origin of spectra, and the information gained had been applied by Bohr to determine the distribution of the electrons round the nucleus of any atom. It had been possible to fix the quantum numbers that characterised the motion of each electron, and to form, at any rate, a rough idea of the character of the orbit.

These planetary electrons divided themselves up into groups, according as their orbits were characterised by one or more equal quantum numbers. For instance, the first element, hydrogen, had a nuclear charge of one, and one electron; the second, helium, had a charge two, and two electrons moving in coupled orbits on the detailed nature of which there was still some uncertainty. These two electrons formed a definite group, known as the K group, which was common to all the elements except hydrogen. For increasing nuclear charge the K group of electrons retained their characteristics, but moved with increasing speed, and approached closer to the nucleus. Passing from helium of atomic number two to neon (10), a new group of electrons was added, consisting of two subgroups, each of four electrons, together called the L group. This group appeared in all atoms of higher atomic number, and, as in the case of the K group, the speed of motion of the electrons increased, and their size of their orbits diminished with the atomic number. When once the L group had been completed, a new and still more complicated M group of electrons began forming outside it, and a similar process went on until uranium, with the highest atomic number, was reached. At the centre of the uranium atom was a minute nucleus surrounded by a swirling group of 92 electrons, all in motion in definite orbits, and occupying, but by no means filling a volume very large compared with that of the nucleus. Some of the electrons described nearly circular orbits round the nucleus; others, orbits of a more elliptical shape whose axes rotated rapidly round the nucleus. The motion of the electrons in the different groups was not necessarily confined to a definite region of the atom, but the electrons of one group might penetrate deeply into the region mainly occupied by another group, giving a kind of coupling or interconnection between the groups. It was possibly too soon to express a final opinion on the accuracy of Bohr's theory which defined the outer structure of the atom, but there could be no doubt that it constituted a great advance. It not only correlated a multitude of isolated facts about the atom, but had shown its power to predict new relations which could be verified by experiment.

Turning to that new and comparatively unexplored territory, the nucleus of the atom, it was natural to suppose that many of the more stable atoms were constituted in a similar way to the heavy atoms, in part at least of helium nuclei and electrons. No indication had been found that the lightest nucleus, *i.e.*, that of hydrogen, was liberated in the transformations of uranium, where the processes occurring were of so fundamental a character. At the same time, it was evident that the hydrogen nucleus must be a unit in the structure of some atoms, and this had been confirmed by direct experiment. The author and Dr. Chadwick had observed that swift hydrogen nuclei were released from the elements boron, nitrogen, fluorine, sodium, aluminium, and phosphorus, when they were bombarded by swift α particles, and there was little room for doubt that these hydrogen nuclei formed an essential part of the nuclear structure. It was significant that the liberation of hydrogen nuclei only occurred in elements of odd atomic number, *viz.*, 5, 7, 9, 11, 13, and 15, the elements of even number appearing to be unaffected. This artificial integration of elements by α particles took place only on a minute scale, and its observation had only been possible by the counting of individual swift hydrogen nuclei by the scintillations they produced in zinc sulphide. These experiments suggested that the hydrogen nucleus or proton must be one of the fundamental units which built up a nucleus, and it seemed possible that the helium nucleus was a secondary building unit composed of the very close union of four protons and two electrons. The view that the nuclei of all atoms were ultimately built up of protons of mass nearly one and of electrons had been strongly supported and extended by isotopes, those elements which showed a close chemical resemblance to other elements. The nuclear theory of the atom offered at once a simple interpretation of the relation between isotopic elements. Since the chemical properties of an element were controlled by its nuclear charge, and little influenced by its mass, isotopes must correspond to atoms with the same nuclear charge but of different nuclear mass. The atomic masses of the isotopes of most of the elements examined had been found, to an accuracy of about one in a thousand, to be whole numbers in terms of oxygen, 16. While the mass of the majority of isotopes were nearly whole numbers, certain cases had been observed by Aston where this rule was slightly departed from. Such variations in mass might ultimately prove of great importance in throwing light upon the arrangement and closeness of packing of the protons and electrons, and for this reason it was to be hoped that it might soon prove possible to compare atomic masses of the elements with much greater precision even than at present. While it might be held as certain that the proton and the electron were the ultimate units which took part in the building up of all nuclei, and the number of protons and electrons in the nuclei of all atoms could be deduced with some certainty, there was little, if any, information on the distribution of these units in the atom, or on the nature of the forces which held them in equilibrium. While it was known that the law of the inverse square held good for electrical forces some distance from the nucleus, it seemed certain that this law broke down inside the nucleus. A detailed study of the collisions between α particles and hydrogen atoms, where the nuclei approached very close to each other, showed that the forces between nuclei increased ultimately more rapidly than was to be expected from the law of the inverse square, and it might be that new and unexpected forces might come into importance at the very small distances separating the protons and the electrons in the nucleus. Until more knowledge was gained of the nature and law of variation of the forces inside the nucleus, it would be very difficult to make progress in the study of the detailed structure of the nucleus. A detailed study of the γ rays from radio-active bodies might be expected to yield information as to the motion of the electrons inside the nucleus, and it might be, as Ellis had suggested, that quantum laws were operative inside as well as outside the nucleus.

The important question of the energy relations involved in the formation and disintegration of atomic nuclei was first opened up by the study of radio-activity. For example, it was well known that the total evolution of energy during the complete disintegration of one gramme of radium was many millions of times greater than in the complete combustion of an equal weight of coal. This energy was, initially, mostly emitted in the kinetic form of swift α and β particles, and the energy of motion of these bodies was ultimately converted into heat when they were stopped by matter. Since it was believed that the radio-active elements were analogous in structure to the ordinary inactive elements, the idea naturally arose that the atoms of all the elements contained a similar concentration of energy, which would be available for use if only some simple method could be discovered of promoting and controlling their disintegration. Unfortunately, although many experiments had been tried, there was no evidence that the rate of disintegration of these elements could be altered in the slightest degree by the most powerful laboratory agencies. With increased knowledge of atomic structure there had been a gradual change in point of view on that important question, and there was by no means the same certainty to-day as a decade ago that the atoms of an element contain hidden stores of energy. It was well known that it was possible by means of electron bombardment or by appropriate radiation to excite an atom in such a way that one of its superficial electrons was displaced from its ordinary stable position to another temporarily stable position further removed from the nucleus. This electron in course of time fell back into its old position and its potential energy was converted into radiation in the process. There was some reason for believing that the electron had a definite average life in the displaced position, and that the chance of its return was governed by the laws of probability. It might be that the elements uranium and thorium represented the sole survivals in the earth to-day of types of elements that were common when the atoms now composing the earth were in course of formation. It was possible to regard the atoms of these elements as having not yet completed the cycle of changes which the ordinary atoms had long since passed through, and that the atoms were still in the "excited" state when the nuclear units had not yet arranged themselves in positions of ultimate equilibrium, but still had a surplus of energy which could only be released in the form of the characteristic radiation from active matter. On such a view the presence of a store of energy ready for release was not a property of all atoms, but only of a special class. It might be urged that the artificial disintegration of certain elements by bombardment with swift α particles gave definite evidence of a store of energy in some of the ordinary elements, but it was very difficult to give a definite answer on this point until more was known of the details of this disintegration.

On the other hand, another method of attack on this ques-

tion had become important during the last few years, based on the comparison of the relative masses of the elements. This new point of view could best be illustrated by a comparison of the atomic masses of hydrogen and helium. It seemed very probable that helium, as mentioned before, was not an ultimate unit in the structure of nuclei. The mass of the helium nucleus 4.00 in terms of O=16, was considerably less than the mass 4.03 of four hydrogen nuclei. There was believed to be a very close connection between mass and energy, and this loss in mass in the synthesis of the helium nucleus from hydrogen nuclei indicated that a large amount of energy in the form of radiation had been released in the building of the helium nucleus from its components. It must be acknowledged that these arguments were purely speculative, as no certain experimental evidence had been obtained that helium could be formed from hydrogen. Information on the subject of energy changes in the formation or disintegration of atoms in general was as yet too uncertain and speculative to permit any decided opinion on future possibilities in this direction, but the speaker had endeavoured to outline some of the main arguments which should be taken into account.

It was a matter of good omen that, in the last few years, the rate of progress retarded by the war had been regained and even intensified; the enthusiasm of scientific workers had never been greater; and there was never a time when there was a more hopeful feeling that great advances were imminent.

LEGAL.

Charge Against Marconi Engineer Withdrawn.

When at the Birmingham Police Court, before the Deputy Stipendiary, Henry Charles Frederick Scott, aged 37, engineer, Moseley, Birmingham, appeared to answer a charge of stealing a sum of £50 from the Marconi Wireless Telegraph Co., Mr. Colin Coley, for the prosecution, applied for the charge to be withdrawn. He explained that Scott had been branch manager for the company in Birmingham and an account was opened upon which he was permitted to draw for expenses. It was his duty to present accounts to the London office showing how he had disposed of the money which he had withdrawn from this account. It was noticed as time went on that there was an ever-increasing balance in hand, and when this had reached an amount just over £308 his attention was drawn to it and he was asked for the money. He did not produce it neither did he give any explanation. As a result the company issued a warrant for his arrest. Since then, however, he had paid over the whole of the £308 on the understanding that the accounts would be gone into and any surplus handed over to him.

Mr. Eaden, who appeared for Scott, associated himself with the application, and added that Scott took over the branch when it was a week old. The business developed to an alarming extent during the wireless "boom" and the turnover between July of last year and July of this year was over £100,000, while the turnover during one month was £40,000. In such circumstances mistakes might easily arise, particularly when Scott was called to other parts of the country in the company's service, and could not attend to the Birmingham office. He disclaimed any felonious intent and submitted that the matter was one of account between him and the company. The Stipendiary allowed the charge to be withdrawn.

Marshall v. Barton.

At Blackburn County Court, on Monday, Thomas Marshall, metal broker, Longton Street, claimed £24 from Thomas Barton, electrician, Ainsworth Street, in connection with work done. It was stated for plaintiff that the parties arranged a contract under which plaintiff was to remove three machines for £12, witness being under the impression that the weight was 3 tons 10 cwt. When he started on the work he discovered they were 6 tons 4 cwt. He alleged that when the difference was pointed out to Mr. Barton he gave him instructions for the work to be continued, and he would pay for the work when it was completed. He admitted that he saw the machines before he quoted £12. The Judge gave a verdict for the defendant, plaintiff to receive £15 which defendant had paid into Court.

Montevideo Tramways.

In August the Judge of the Civil Court, Doctor Minelli, gave judgment in the action brought by the Municipality of Montevideo against the local tramways companies for payment of fines to the value of $231,930 (Uruguayan gold) imposed for stoppage of service during the last strike. The Judge finds that the companies were not to blame in any way for the stoppage of the services and the claim of the Municipality is accordingly disallowed.—*The Review of the River Plate.*

CORRESPONDENCE.

Letters received by us **after 5 p.m. on Tuesday** *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

The Welding Current of Oil Switches.

The conclusions reached by the author of the above article are effectively discounted in his first paragraph, wherein he states that comparatively few of the important problems affecting oil-switch design can be solved from first principles.

The calculations appear to be concerned more with arcing contacts than with main contacts, but in either case the large number of unknowns present render the application of a formula of doubtful value.

In the first place, the resistance of the contacts is not known even approximately, since the contacts are either attracted together or repelled, according to design, with considerable force on the passage of short-circuit current.

The period during which the contacts carry short-circuit current (assumed in the article to be 0.2 sec.) depends not only on the inherent speed of operation of the switch, but upon the time lag of the protective gear employed. This fact is made use of in determining the rupturing capacity required in any particular situation, and not in estimating the rupturing capacity (usually given in this country in kVA) of any particular circuit-breaker.

The period during which the arcing contacts carry current depends also on the point in the travel of the moving mechanism reached before the circuit is broken.

The amount of copper available to absorb heat depends on the period available for conduction, this period varying as stated above.

When we add to the above unknowns the constants of the various machines which may be connected to any system, we arrive at an equation which may be made to give almost any result desired; this is perhaps the reason for the calculated results agreeing with figures obtained in practice.

I am of the opinion that a mathematical treatment of such a subject is liable to give very misleading results.

T. J. Barfield.

London, *September 10th*, 1923.

British Empire Exhibition, Wembley, 1924.

May I suggest for the consideration of those who arrange visits to works and other centres of interest for the various scientific and engineering societies, that during the coming winter the site of the great Exhibition at Wembley would be a very suitable place to include in any such round of visits.

I believe there would be no great difficulty in obtaining passes from the authorities if the party were of a reasonable size, and although visits would have to be made during daylight, there is no doubt they would be of value and increase general interest in this enterprise; even at the present time the buildings and constructional plant are most impressive to anyone interested in the engineering industry.

J. W. Beauchamp,
Director and Secretary,
British Electrical Development Association, Inc.

London, *September 10th*, 1923.

Power Factor Indicators.

Mr. C. L. Lipman, in his letter of August 31st, draws attention to several general points of resemblance between his power factor meter and that described by me in your issue of August 3rd. He even hints, in fact, that mine is but a copy of his design. May I, therefore, beg the hospitality of your columns in which to state that this is not in any way the case. The chance similarities which he quotes have nothing to do with the theory underlying my construction.

The use of 120° spacing, for instance, is almost inevitable, since the fact that three-phase systems have their phases spaced at this angle practically precludes any other arrangement.

On the other hand, the use of the same angle, *i.e.*, 120°, in my design, for single- and two-phase instruments has many advantages, and has been adopted by me in *preference* to the usual 90°.

The evolution of the three designs, due to Dr. Gifford, Mr. Lipman, and the writer, would seem to be roughly as follows:

The fundamental instruments were those of Punga (or Tuma) and Conrad in the U.S.A. Dr. Gifford dispensed with the ligaments required in the Punga instrument by leading the current into the rotor by transformer action. Mr. Lipman placed three Conrad instruments one on top of the other, at the same time allowing each individual segment to swing in its own current coil. All credit is due to Mr. Lipman for designing the latter arrangement, which he adopted to eliminate the magnetic drag with which he appears to have been troubled, but which, by suitable shaping of the irons, I have found to be negligible in its effect.

With particular reference to the three-phase "induction"

instrument, described in my article, however, I claim the following points of originality and superiority in design:—

(1). The pressure coils, being wound in pairs, and connected astatically face to face with a narrow gap between, have a higher internal power factor, *i.e.*, .999, than any other construction.

(2). For the same reason they are free from temperature and frequency error over ranges enormously wider than those permitted by any other design.

(3). The moving system weighs less than 5 grams.

(4). The moving irons are so shaped as to reduce rotational drag to a negligible quantity.

(5). The magnetic system is influenced directly by all three-phase voltages without any mutual interference, and occupies a total height of less than 2½ in.

(6). The "unbalanced" power-factor meter is suitable for a three-phase, four-wire circuit, and will read correctly on any load, balanced or unbalanced, or even on one phase only, should only one phase be loaded, or the transformers of the other two short-circuited at the time, for the purpose of getting the p.f. of the individual phases.

I have, Sir, I trust, made it clear that my design, as manufactured by Everett, Edgcumbe & Co., Ltd., is in no way a copy of those mentioned by Mr. Lipman. In fact, I may add that similar schemes to these latter were tried out by us some years ago, and discarded on account of their failure to comply with the conditions which we had laid down as essential in a satisfactory power-factor meter.

Francis E. J. Ockenden.

London, *September 10th*, 1923.

"Difficulty in Starting."

I do not wish to discourage "S. R. D.," but would like to point out to him that he may go a good deal further and still be on the waiting list.

I am the same age as he, and since discharge from H.M. Forces have passed the following examinations:—

London City & Guilds Institute Finals in both electrical and mechanical engineering.

The London University Inter. B.Sc. (Pure & Eng.).

I have the honour to be a graduate of the Institution of Electrical Engineers.

In the recent competitive examination for inspectors in the G.P.O. I came thirtieth in All England, having the satisfaction of beating many university men.

In practical work I have had a thorough and varied experience, from charge of manufacture and erection of power plant installations for the Government to grinding up large commutators in power houses. At the beginning of this year I made a change to gain further experience, and am now in the drawing office of a well-known London and Midland firm of electrical engineers, but at a very meagre salary.

I am determined to take my degree next year, but what if I do? I am not wanted in England; write where I may, without mentioning salary, I receive the reply: "No Vacancies."

Is it worth while carrying on? What do I lack? There must be something, and for that reason I sign myself

Minus.

September 4th, 1923.

Heat Balance of Boiler Plant.

On reading over my article in your issue of the 31st ult., I note that the hydrogen loss calculation is not quite correct, as I have omitted a pair of brackets; the formula should read thus:—

$$9H\,([212 - t] + 970.4 + 0.47\,[T - 212])$$

The "H," of course, is the hydrogen fraction of the coal *as fuel*, and includes the hydrogen in the moisture.

Chas. F. Wade.

Sheffield, *September 6th*, 1923.

RADIO DIRECTION FINDING.

The Radio Research Board's Report.

The discussion of the practical systems of radio direction-finding by reception, published by the Radio Research Board,* is the first of a series of special reports dealing with the work of the Board established under the Department of Scientific and Industrial Research. The investigations described in the present report, No. 1, were carried out by Messrs. R. L. Smith-Rose and R. H. Barfield on behalf of the Directional Wireless Sub-Committee of the Board, chiefly at the latter's station at the Admiralty Compass Observatory at Ditton Park, Langley, Bucks.

The report is divided into three parts: In Part I the simple theory of a closed loop in an electromagnetic field and of two single-coil, Bellini-Tosi, and Robinson direction-finding systems is outlined and the effect on them of inclination and polarisation of wave-front is indicated.

Part II contains a comparison of the above-named direction-finding systems. The comparison of the Bellini-Tosi and Robinson systems was made at the Slough Research station of the Board, the duration of the experiments being three months. The range of damped wave-lengths dealt with was from 2 km. to 5 km., and the standard deviation of the systems for each of nine transmitting stations during the day shows the value of this for the Bellini-Tosi system to be slightly greater than that for the Robinson system.

The permanent error, *i.e.*, the difference between the mean bearing for the period and the true bearing is of the same order for both systems, varying from +0°.1 to −1°.5 and +0°.1 to +2°.2 for the Robinson and Bellini-Tosi respectively. However, although of the same order, they are sometimes of different sign; whether this discrepancy is due to difference in instrumental errors or to the slight difference in the local surroundings of the systems is to be determined by further experiments.

At night both systems show a liability to variable errors of apparently the same amount, the similarity of the maximum variation detected and the standard deviation for each station being very noticeable. The extremely broad minima often accompanying the phenomenon of night-effect might be expected to be the cause of large observational errors which might result, in some cases, in widely different observations being obtained. The signal strength on both sets was practically the same.

The comparison of the single-frame, Bellini-Tosi, and Robinson systems on damped and undamped waves of lengths from 1.8 to 9 km. was also made at Slough, the work lasting a month. During day work eleven different transmitting stations were observed, and on these only very slight differences existed between the systems. The standard deviation was worked out and it indicated that the difference in accuracy of the three sets was practically negligible.

The permanent errors, *i.e.*, the day average minus the true bearing, vary in the case of the Robinson set from −2°.0 to −1°.0, in the case of the Bellini-Tosi from −2°.1 to −1°.1, and for the single-coil system from −1°.5 to−°.8. The results obtained at night show that in this particular experiment no very large errors were recorded on any of the sets, the greatest deviation from the day mean amounting to 5°.4. They also show that the errors are of the same order for each system, and that although there is a noticeable agreement between the three systems of some of the individual readings, there is distinct difference between others.

Comparison of Bellini-Tosi and Robinson systems on damped and undamped waves of length 2 to 9 km. was made with the permanent Bellini-Tosi set at H.M.W/T. station at Orford for a period of five weeks.

The observations obtained in the day periods show that on the Bellini-Tosi set the extreme bearings on the different stations vary over a range of from 0°.5 to 7°.5, the corresponding range on the Robinson set being from 0°.2 to 3°.7. The largest variations on the Bellini-Tosi set were obtained on Leafield, being 6°.0 and 7°.5 for the marking and spacing waves respectively, while on the Robinson set the corresponding variations were 1°.3 and 1°.9. On the other hand, the largest variations obtained on Ongar were 3°.7 on the Robinson and 2°.5 on the Bellini-Tosi set.

In general the results show that extreme variations from the mean of more than 2° are comparatively rare on either set. It is thus possible that the larger errors on the Bellini-Tosi set mentioned above were observational errors, as these are easily possible when taking quick swings over large angles. On the Robinson set the observations could usually be made to 1° or less in the day-time, so that the possibility of observational errors is much reduced. The smaller variations of from 1° to 2° on either side of the mean must be taken as definite day variations, since they occur simultaneously on two independent sets. This is now generally recognised as the order of normal day variations.

In spite of these variations, in most cases the mean bearing on both sets is correct to within a fraction of a degree. In the case of Paris, however, there is a discrepancy of nearly 1° between the two sets, the error on the Bellini-Tosi set being nearly double that on the Robinson set, on both wave-lengths. There is also a discrepancy of more than a degree between the mean bearings obtained on the three transmissions from Ongar.

The observations made during the evening periods, excluding Paris, show that the total variations at night range from

*H.M. Stationery Office, price 9½d.

5°.0 to 54°.0 for the Bellini-Tosi set, and from 5°.2 to 51°.3 for the Robinson set. In each case the variations and the systematic errors of the means are of the same order for each set.

In the case of Paris the variation on either set is very small. The mean bearings on this station at night are identical with those by day, and the error referred to with respect to day readings is thus the same. Apart from this transmitting station, however, there is no essential difference between the variations and errors experienced on either damped or undamped waves.

The signals obtained on the Bellini-Tosi set were no stronger than those on the small portable Robinson coil set, using the same amplifying apparatus.

It is not the purpose of the present paper to enter into a discussion of the magnitude, frequency, and possible causes of the variations of bearings experienced at night as this matter has been the subject of an investigation on a wide scale conducted by the Radio Research Board for some time past.

Part III is a general discussion on the operation of the three systems. The experimental results confirm the theory which shows that all three existing systems of direction-finding are fundamentally identical with a single-turn loop rotating about a vertical axis. Whatever distortion is produced in an arriving electromagnetic wave by geographical features, &c., and whatever may be the cause of the variations experienced both by day and night, all three systems are affected to the same degree. Although by night the variable errors which are constantly present are very much larger than the possible errors of either instrument or observer, this is not true for general daylight working.

The Bellini-Tosi system is the most complicated of the three, and accordingly has a greater liability to instrumental error. By the use of a compensating condenser the zeros of signal strength can be made very sharp, and bearings were frequently readable to within 0°.2, and sometimes to 0°.1. At this accuracy movement of the operator must be avoided, since he contributes to the "antenna" effect for which compensation is made. Swing observations considerably decrease the accuracy, for it is not easy to limit the extremes of the swing to fractions of a degree, and the bearing obtained is usually a multiple of half a degree.

The Robinson system is undoubtedly most useful for watching a station to observe small or large variations. With the modern sets employing a large ratio of the coils, the alleged 90° ambiguity of this system is entirely eliminated. The actual zeros obtained with either the Bellini-Tosi or single-frame sets were noticeably sharper with heterodyned undamped waves than with damped waves, a point which is explained by Mr. S. Ballantine as due to the greater sensitivity of a detector for undamped waves.

On a fixed wave-length the Bellini-Tosi system is the quickest to operate, and using untuned aerials this advantage is retained over a range of wave-lengths. Where extreme rapidity is not, however, necessary, the single frame would appear to be just as efficient. In the presence of large external noise the Robinson system is claimed to be the best, but the present authors have as yet had no experience of this.

A NEW IMPULSE MOTOR.

A Small D.C. Low-speed Machine.

Mr. W. F. Joachim, of the Langley Memorial Aeronautical Laboratory, describes in the *Journal* of the Franklin Institute, a d.c. impulse electric motor that was designed by the staff of the American National Advisory Committee for Aeronautics for the purpose of driving the film drums of recording aircraft instruments. As will be seen from the accompanying drawing the working parts of the motor are few and simple. They consist of four spool-type field coils, a reciprocating armature, a ratchet wheel and two pawls. The field coils, operating in pairs, alternately pull the armature from one pair of pole faces to the other pair. This reciprocating motion is transmitted to the ratchet wheel through the two pawls, motion in either direction producing a positive advance of the wheel. Rotation of a very regular character is thus secured. The motor is 1¼ in. long, 1 3-16 in. wide, and ¾ in. high, with a volume of 1.43 cu. in. and a weight of 0.165 lb. It produces approximately 6.0×10^{-4} h.p., with an efficiency of 1 per cent. The speed range is from 0 to 35 r.p.m., the torque being .234 pound-inch at the lower speeds with 8 volts applied. Due to its small size and light weight, its inherent low speed and property of absolute synchronisation, the motor is particularly well adapted to aircraft instrument work. Application of this type of power source may also be made to automatic recording instruments of all kinds, to indicating devices requiring absolute precision of movement, and to remote control work.

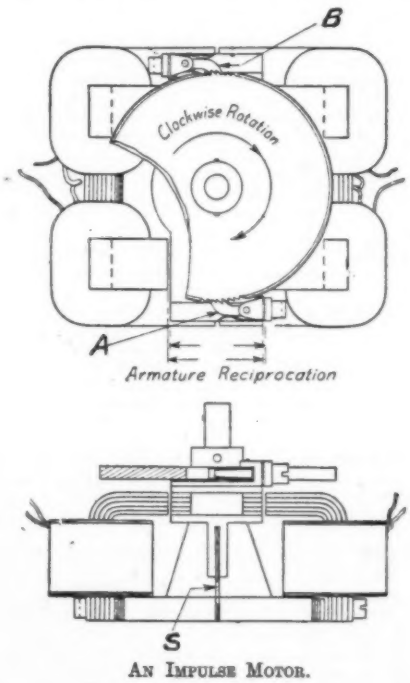
To meet the requirements three forms of mechanical drive and two types of electric motor were tried, but proved to be inadequate and unsatisfactory. The final form of the motor, however, utilises the motion of the armature in either direction.

Referring to the figure, it will be seen that the ratchet wheel rotates about a vertical axis passing through the centre of the motor; also that it lies above the field poles and reciprocating armature, and between the two pawls, the latter being mounted in brackets at either end of the armature. The armature is supported by two leaf springs S fixed in the base and is returned by these springs from either pair of pole faces to a neutral position half-way between them. The moving parts of the motor consist of the armature, the two pawls, and the ratchet wheel; there are no connecting rods or bell cranks.

Assuming the left electromagnet to be energised, the action from the neutral position is as follows: The armature is pulled to the left until it reaches the pole faces of the left electromagnet. During this motion pawl A has rotated the wheel clockwise one-quarter of a tooth. At the same time pawl B has ratcheted back in a counter-clockwise direction one-quarter of a tooth and has dropped into position behind the tooth over which it has just moved. The armature is now in position for a complete power stroke from left to right.

Assuming the left electromagnet to be de-energised, the armature springs S start to return the armature to the neutral position. This action does not rotate the wheel under load, but only takes up the slight play between pawl B and the three teeth of the wheel on which it is now exerting some pressure. Approximately one-sixtieth of a second elapses during the above action, after which the right electromagnet is energised.

The armature is now pulled to the right until it reaches the pole faces of the right electromagnet. During this motion pawl B rotates the wheel clockwise, as before, one-half a tooth. At the same time pawl A is ratcheted counter-clockwise also half a tooth. Since the wheel has been rotated clockwise a half tooth and pawl A moved counter-clockwise a half tooth, the relative motion between the two is equal to a whole tooth. Therefore, pawl A drops into position behind the tooth over which it has just moved. Thus the power stroke has been



An Impulse Motor.

completed and the armature brought into position for the following stroke from right to left.

The maximum air gap required in this motor between the armature and either pair of pole faces is about 0.008 in. and varies in operation from that value to zero, so that the average gap is only 0.004 in. Hence the efficiency of the magnetic circuit is high. This is accomplished by using

ratchet teeth of small pitch, and by the fact that a complete power stroke requires an air gap of only one-half the tooth pitch.

The alternate energising and de-energising of the left and right electromagnets is accomplished by a distributor driven by a constant-speed motor in an average case at about 720 r.p.m. The distributor makes and breaks the electric circuit for each electromagnet of the motor once for each revolution. This speed is readily controlled so that a range of from zero to 16,800 power strokes per minute may be realised. This gives a motor speed range of from zero to 35 r.p.m. Thus absolute synchronism between any number of motors is readily obtained by merely taking their current supply from the same distributor, and any number of instruments may not only be operated in absolute synchronism with each other, but, if the distributor be chronometrically controlled, absolute speed regulation and timing may also be realised.

To obtain the best efficiency from the motor, the current supplied through the distributor-commutator should be cut off the instant the armature has completed its power stroke. In order to accomplish this result, without any complication, the correct length of the distributor-commutator segment, which makes and breaks the circuit and thus produces a power stroke, was determined by test for all speeds and torques.

The advantages of the impulse type of motor for instrument work not already mentioned are: Low current consumption, thus decreasing the number of storage batteries necessary for average flight work to approximately 40 per cent. of the present requirement; constant torque at the speed range used; high efficiency for its size; normal speed instantaneously on closing the switch; dead stop instantaneously on opening the switch; remote control of speed of all motors in operation from the distributing source; long life due to low bearing pressures, the pawl-bearing pressure being 300 lb./sq. in. and the main-bearing pressure 12 lb./sq. in.; low construction cost due to its few parts, spool-type coils, and the elimination of rotating contacts and brushes.

BUSINESS NOTES.

Bankruptcy Proceedings.—Cyril Walter Stocken and Conway Fink, trading as The Wyndham Radio Supplies, 80, Redcliffe Street, Bristol.—According to the statement of affairs the liabilities amount to £754, and the assets, after deducting preferential claims of £51, are estimated to produce £347, leaving a deficiency of £407. Debtors attribute their failure to insufficient turnover since the commencement of the business, slackness of trade during the summer months, want of capital, and pressure by creditors. Debtor Stocken states that he was employed as a clerk prior to December, 1914, when he joined H.M. Army. After being demobilised in May, 1920, he was, for about fifteen months, outside representative for a gas and coke company at Exeter. Debtor Fink states that he was also employed as a clerk until September, 1915, when he joined H.M. Army, and served until May, 1919. He then travelled for a firm of motor electricians for about fifteen months, and for the next fifteen months he was employed as an engineer. In September, 1921, he commenced business without capital at Colas Mews, Birchington Road, Kilburn, as an electric lamp factor, but he did not trade successfully, and in the following December he gave up the business, and arranged to pay his creditors by instalments. On March 22nd, 1922, the debtors commenced business in partnership at Bristol as wireless engineers. About a month later they removed to their present address, but neither of them had any capital, and they borrowed £150, which they expended in stock, and a month later they borrowed a further sum of £12 to meet an account. The debtors stated that most of this class of business was done principally in the winter months, but owing to the delay in establishing British broadcasting, which did not come into force until January last, they had been unable to develop their business. They state that they became aware of their position about a month ago.

F. B. Young (F. B. Young & Co.), mechanical and electrical engineers, 45, Queen Street, and 16, Restalrig Gardens, Edinburgh.—Public examination September 18th, at the Sheriff Court House, George IV Bridge, Edinburgh; meeting of creditors October 24th, at 87, St. Vincent Street, Glasgow.

J. E. Elliott & Co., electrical engineers, 12, Broad Street, Oxford.—First meeting September 17th, at 1, Saint Aldates, Oxford; public examination October 15th, at the County Hall, Oxford.

George Reginald Topliss, electrical engineer, 9, Palatine Chambers, Halifax, Yorkshire.—The following are creditors:—

	£		£
E. T. Maunder	100	K. A. Greene	20
H. M. Geffery	70	Halifax Office Supplies Co. ...	15
S. Geffery	20	Neill & Co.	65
Mrs. G. H. Topliss	25		

Charles Wright & Herbert Thomas Wright (trading as Wright Bros.), 251, Fulham Road, S.W., electrical engineers.—A sitting of the London Bankruptcy Court was held on Tuesday before Mr. Registrar Francke for the public examination of these debtors, who failed in July, with total liabilities £3,071 (unsecured £2,429), and net assets valued at £423, after deducting £191 for payment of the preferential claims. Replying to Mr. Armstrong, Official Receiver, the debtor, Charles Wright, stated that he started business in partnership with his brother in 1902, as electrical engineers, under the style of Wright Bros., at 5, Queen's Elm Parade, Fulham Road, Chelsea; they removed to larger premises at 6, Queen's Elm Parade in 1906, and again in 1913 to still larger premises at 251, Fulham Road. The business mainly consisted of wiring premises for electrical services, and dealing in electrical sundries; it was successful until 1920, but subsequently was carried on at a serious loss. The firm's failure was caused by depreciation of stock, machinery and fixtures, law costs, sheriff's charges, slump in trade since 1920, with the consequent loss in trading and lack of profit to meet their household and personal expenditure. A full set of books of accounts had been kept, and they were audited until 1921, but subsequently, owing to lack of funds, debtors were unable to employ an accountant, and the books had not been fully entered up, nor had any trading or profit and loss accounts been prepared. They first realised their insolvency in January, 1922, when being pressed by creditors they borrowed £500 to enable them to carry on, but were unable to tide over, and in May last they were forced to give notice of their intention to suspend payment. Over £2,000 of their present liabilities represented cash advanced and interest thereon. The witness's separate account showed personal liabilities £568, and an estimated surplus in assets of £74, after payment of all debts. The debtor Herbert Thomas Wright confirmed the evidence given by his brother, his separate estate account showing a surplus of £20. The examination of both debtors was ordered to be concluded. Appended is a list of the principal unsecured creditors:—

	£		£
Aldridge, H. T.	15	Metropolitan-Vickers Electrical Co., Ltd.	92
Ashton, E. B., & Co.	100	Robbins, A. J.	300
Brown, E.	23	Willett, H.	519
Bingham & Sons, Ltd.	16	Weston, F., Ltd.	18
Bridges & Co.	16	Wright, Mrs.	300
British Thomson-Houston Co., Ltd.	40	Employers' Liability Association...	12
Evered, C.	65	Levi, E.	55
Lannering, H. B.	60	Walker, Mrs.	115
King, R. M.	100	Fully secured creditors	490
Knight & Williams	19	Rent	85
March, C. W.	500	Rates	191
Nicholls Bros.	12		

Company Liquidations.—Magnus Volk, Ltd.—A meeting of members is called for October 15th, at 58, Ship Street, Brighton, to hear an account of the winding-up from the liquidator, Mr. R. Carpenter.

Scarborough Tramways Co., Ltd.—First meeting of creditors and contributories, September 20th, at the Balmoral Hotel, Westborough, Scarborough.

Submarine Motor Ship Cleaner Syndicate, Ltd.—First and final dividend of 9½d. in the £, payable September 17th, at the Official Receiver's Offices, Carey Street, W.C.

Trade Announcements.—Mr. T. A. Nunwick, of 314, Produce Exchange Buildings, Manchester, has relinquished his connection with Messrs. Pritchett & Gold and E.P.S. Co., Ltd., for whom he has acted as agent for Lancashire and Yorkshire during the past ten years, and he has been appointed agent for the counties of Lancashire and Yorkshire by Accumulators of Woking, Ltd.

Messrs. Henry Hollingdrake & Son, Ltd., Prince's Street, Stockport, have opened new showrooms for electrical goods.

The Efficient Electrical Co., which is opening a new showrooms and offices at 21, Chichester Street, W., wishes to receive catalogues and lists of electrical plant and accessories.

The British Thomson-Houston Co., Ltd., has opened a new branch depôt (with showroom and stores) at 31, Linenhall Street, Belfast, to deal with all business in the North of Ireland, which has hitherto been handled by the company's Dublin office.

Catalogues and Lists.—The British Thomson-Houston Co., Ltd., Crown House, Aldwych.—A series of attractive pamphlets and posters dealing with various types of "Mazda" lamps and fittings in an informative manner. Also Lists Nos. 2,190 and 4,153 B, dealing respectively with variable-speed commutator motors and oil-immersed circuit breakers. Illustrated.

The Sun Electrical Co., Ltd., 118-120, Charing Cross Road, W.C.2.—September price list of electrical supplies announcing reduced prices of "Sunco" electrical fires.

Impag, Ltd., 101, Leadenhall Street, E.C.3.—An illustrated brochure dealing with oil-testing apparatus, oil heaters, coil winders, &c., made by Micafil, Ltd., Switzerland, for which the Impag Co. is British agent.

The Carpax Co., Ltd., 312, Deansgate, Manchester.—A folder dealing with the "Homcharger" set for battery-charging, and announcing a reduction in price.

Lanston Monotype Corporation, Ltd., 43 and 43a, Fetter Lane, E.C.4.—A pamphlet advertising a grip-control switch for electrical appliances.

The India Rubber, Gutta Percha and Telegraph Works Co., Ltd., Silvertown, E.16.—An illustrated pamphlet describing a self-contained electrical measuring set.

The Electrical Supplies Co., 233, Tottenham Court Road, W.1.—A price list of opal glass bowl fittings and accessories.

The Parsons Motor Co., Ltd., Town Quay Works, Southampton.—Two well-illustrated and priced brochures dealing respectively with oil and petrol engines, and gears and fittings.

Messrs. Johnson & Phillips, Ltd., Charlton, S.E.7.—Catalogue M, containing particulars and prices of ammeters, voltmeters, frequency meters, and other electrical instruments of various patterns.

Metropolitan-Vickers Electrical Co., Ltd., Trafford Park, Manchester.—Circulars Nos. 1250/2, dealing with the breaking capacity of oil circuit-breakers, and 1302/1, on high-voltage bushing insulators. Also Descriptive Leaflet No. 255/1-1, describing the firm's "Type K" oil circuit-breaker.

Fuller's United Electric Works, Ltd., Chadwell Heath, E.—List No. 250 A, giving particulars and prices of blocks- and plate-type accumulators for automobiles, radio-telegraphy and telephony, &c.

Siemens & English Electric Lamp Co., Ltd., 38-39, Upper Thames Street, E.C.4.—September trade price list of electrical accessories of all descriptions.

Messrs. Veritys, Ltd., Aston, Birmingham.—Publication No. 945, a profusely-illustrated catalogue of "Maxlume lighting fittings for industrial applications, &c. Also a priced leaflet dealing with a new desk fan.

Marconi's Wireless Telegraph Co., Ltd., Marconi House, Strand, W.C.2.—Pamphlet No. 217, containing an illustrated and fully-detailed description of Type U telegraph and telephone transmitters.

Messrs. Plessey Co., Ltd., Vicarage Lane, Ilford, Essex.—An illustrated leaflet describing a variable-speed machine for winding small coils.

Messrs. Hardy & Padmore, Ltd., Worcester Foundry, Worcester.—Sheet No. 9,104, bearing an illustration and description of a new transformer casing.

Sterling Telephone & Electric Co., Ltd., 210-212, Tottenham Court Road, W.1.—Publication No. 374, describing and illustrating "Sterling" head and hand telephones. Priced.

The Consolidated Pneumatic Tool Co., Ltd., 170, Piccadilly, W.1.—Welding Circular No. 82, illustrating arc welding and air-compressing plant.

British Insulated & Helsby Cables, Ltd., Prescot, Lancs.—An illustrated booklet dealing with the "Prescot" wiring system. Priced. Also a list of the firm's manufactures.

Ateliers de Constructions Electriques de Charleroi, 56, Victoria Street, S.W.1.—September stock list of motors and dynamos.

The Wholesale Fittings Co., Ltd., 23-27, Commercial Street, E.1.—A priced and illustrated list of "Supastone" glass bowls and shades for electric lighting.

Messrs. Crompton & Co., Ltd., Chelmsford.—A well-illustrated descriptive brochure dealing with the principles and construction of polyphase auto-synchronous motors.

Messrs. I. Calvete, Ltd., 11, Little St. Andrew Street, W.C.2.—Illustrated pamphlets advertising violet ray apparatus.

The Whitworth Electric Lamp Co., Ltd., 195, North End Road, West Kensington, W.14.—A net trade price list of lamps, cables, lighting fittings, switch- and fuse-gear, &c.

Messrs. Donovan & Co., 47, Cornwall Street, Birmingham.—Current price list of electrical supplies.

Messrs. Mann, Egerton & Co., Ltd., 175, Cleveland Street, W.1.—A panoramic view of the principal Government buildings, Whitehall, in many of which the firm has carried out electrical contracts.

The Relay Automatic Telephone Co., Ltd., Marconi House, Strand, W.C.2.—An illustrated booklet describing the "Relay" system.

Messrs. C. H. Parsons, Ltd., Britannia Works, Tyseley, Birmingham.—A new price list of tumbler switches, lampholders, &c.

Engineering Supplies, Ltd., 155a, Upper Thames Street, E.C.4.—An illustrated and priced catalogue of electrical novelties, toys, &c., as well as switches, bell pushes, instruments, and other accessories.

Messrs. Watson & Sons (Electro-Medical), Ltd., Sunic House, Parker Street, Kingsway, W.C.2.—Bulletin No. 56S, describing the "Sunic" X-ray combination, horizontal couch, vertical screening stand, and high-pressure transformer.

Messrs. Norrington & Landon, Ltd., 33, Brazennose Street, Manchester.—Publication No. 215, describing "Blaizolite" patent projector lanterns. Illustrated and priced.

Trade Pageant at Cardiff.—A special shopping week is being arranged by the municipal authorities to take place from October 1st to 6th, and there is to be a trade "pageant" on October 4th. It is hoped that electrical firms will avail themselves of the opportunity to enter displays in one or more of the twelve classes. Applications must reach the organiser, Mr. T. W. D. Smith, City Hall, Cardiff, not later than the first post on September 22nd.

Book Notices.—*The Decimal Educator*, September, 1923. London: The Decimal Association. Price 6d.—In the current issue Mr. C. Harpur disposes of the anti-metrical contentions of an opponent of the movement; the case for the metric system is strengthened by contributions from Prof. Sydney Young (Trinity College, Dublin) and Mr. G. D. Shepherd. Mr. A. J. Stubbs deals with the application of metric measures in the United States and the British Empire; and there are numerous other items of practical and historic interest.

"The *Journal* of the Junior Institution of Engineers," Vol. XXXIII, Part XII. September. London: Percival Marshall and Co. Price 2s.—The principal paper reproduced in this issue is one entitled "Electrons and Ionisation of Gases," by P. L. Edmonds, Wh.Ex., read before the Loughborough Section. In addition to this there are book reviews, reports of visits, &c. The index to Vol. XXXIII is also embodied in the number, as well as a list of the officers and past-officers of the Institution.

"The *Transactions* of the S.A. Institute of Electrical Engineers." Vol. XV, Part 7; July. Johannesburg: The Institute. Price 2s.—In this issue are included papers on "Electricity Supply Plants in Southern Rhodesia," "A Few Notes on the Resistance-Capacity Method of Radio-Frequency Amplification," "Air-Core Transformers," and "Grid Leaks."

"Electrical Measuring Instruments and Supply Meters," by D. J. Bolton. Pp. xvi+328; figs. 180. London: Chapman and Hall, Ltd. Price 12s. 6d. net.

"Lighting Circuits and Switches," by T. Croft. Pp. xii+472; figs. 556. London: McGraw-Hill Publishing Co., Ltd. Price 15s.

E.D.A. Salesmanship Conferences.—The British Electrical Development Association, Inc., has issued a programme for its 1923-24 series of Salesmanship Conferences. The details are as follows: September 21st, Papers on "The Scope and Object of E.D.A. Salesmanship Conferences," and "Some Notes on the Commercial Aspect of Electric Lighting," by Mr. J. W. Beauchamp; chairman, Mr. W. B. Woodhouse, M.I.E.E. October 19th, Paper on "How to Organise and Promote Retail Showroom Sales," by Mr. H. W. Roberts (G.E.C.); chairman, Mr. S. T. Allen (Wolverhampton). November 16th, Paper on "How to Sell 'Heat,' and Problems Relating to the Warming of Air and Body," by Mr. A. F. Berry (British Electric Transformer Co., Ltd.); chairman, Major H. Richardson, M.C. December 14th, Paper on "Advertising in the Electrical Industry in Relation to the Retailer or Contractor," by Mr. W. E. Warrilow; chairman, Mr. H. Marryat. January 18th, 1924, Paper on "How to Market 'Hot Water' for Domestic and Heating Purposes," by Mr. C. G. Nobbs; chairman, Mr. J. H. Bowden (Poplar). February 15th, "How we Placed the First Hundred Cookers," by Mr. R. A. Lower (Norwich); chairman, Mr. L. L. Robinson (Hackney). March 21st, Paper on "Electricity the Real Domestic Help," by Mr. E. E. Hoadley (Maidstone); chairman, Mr. A. G. Beaver (Sun Electrical Co., Ltd.). April 11th, Paper on "Selling Electric Power"; chairman, Mr. B. Longbottom (Electromotors, Ltd.). The meetings are to be held at the St. Bride Institute, Fleet Street, E.C.4.

Trade with West Indies.—In an article contributed to the *Board of Trade Journal*, Mr. A. W. H. Hall, of the Trade Commissioners' Office, Trinidad, says that important orders have been obtained by Canadian and American firms in the British West Indies recently. Their success is attributed to the presence of representatives on the spot, or their willingness to send out representatives. Cases in point are the supply of electric lighting plant to San Fernando, Trinidad, and to towns in the Leeward and Windward Islands by an American firm, and the construction of railway extensions in Jamaica by a Canadian firm.

New Schedules of Railway Charges.—At a meeting of the Mansion House Association on Railway and Canal Traffic, held at the offices last Friday, the schedules of standard rates submitted by the railway companies to the Rates Tribunal were considered at length. The Association will give every assistance to its members in lodging the necessary objections to the railway companies' proposals.

British Empire Exhibition. — The Blackburn Town Council has decided to subscribe £100 to the expenses of the British electrical display at the Exhibition.

E.D.A. Activities.—A striking pamphlet has been issued by the Electrical Development Association to show the magnitude of the British Empire Exhibition. A picture of London's heart (the Trafalgar Square district) is reproduced on one side of a double paged pamphlet, while opposite this a plan of the district is printed with outline plans of the Halls of Industry and Machinery superimposed, conveying a very clear conception of the size of just these two components of the exhibition.

With this the Association has sent us two interesting Press items reproduced in leaflet form. One is a note of Dr. C. P. Steinmetz's recent remarkable declaration on the future of electricity, forecasting a four-hour working day. The other is a pronouncement by a prominent surveyor regarding the ravages of smoke upon the fabric of ancient buildings—and proposing as a remedy the use of electricity.

Annual Outing.—The works of the "D.P." Battery Co., Ltd., were closed on Saturday last, on the occasion of the annual works' outing. Blackpool was again visited, and the party, which was larger than last year, travelled in five reserved saloons on a special train, which left Bakewell shortly before 5 a.m. Favoured with delightful weather, the outing proved a great success.

Garden Party.—On Saturday last, the Social Society of the County of London Electric Supply Co., Ltd., held its seventh annual horticultural exhibition and garden party at Oaklands, Clapham Park. There was a large attendance of members and their friends, and great interest was shown in the sports and other entertainments. During the afternoon music was provided by the band of the 6th Battalion City of London Rifles, and in the evening there was an al-fresco concert by "The Motleys," followed by dancing on the lawn.

The exhibition was markedly successful, some excellent exhibits of vegetables and flowers hailing from such unlikely situations as a sub-station yard or the roof of a house; several charming collections of flowers, &c., were contributed by friends (not for competition), and the whole of the exhibits were to be handed over to local hospitals. The prizes were presented to the winners by Lady Renwick in the unavoidable absence of the president, Sir Harry Renwick.

Foreign Exhibition.—NORWAY.—The Norwegian Industries Fair was opened on September 2nd by the Minister of Commerce. The fair includes 300 exhibitors, representing 20 of the most important industries in Norway, and is being attended by buyers from nearly all the countries of Europe.—*Reuter* (Christiania).

Lead.—In their report dated September 8th, Messrs. James Forster & Co. state:—"Business with home consumers continues very quiet and is certainly not responsible for the rise, which was due more to sympathy with the good tone in other metals than to the intrinsic position of lead itself. Arrivals have been pretty heavy this week, including about 3,500 tons in one bottom from Mexico. . . No doubt some of this lead will find its way into warehouse to replace lead withdrawn during the strike."

British Trade Mark Applications.—The following are among the recent applications for British trade marks. Objections to any of the proposed marks may be entered within one of the dates mentioned. In the case of foreign applications the names and addresses of the British representatives are also given:—

Monotype. No. 436,459. Class 6. Electric motors, &c. The Lanston Monotype Corporation, Ltd., 43 & 43a, Fetter Lane, London, E.C. September 5th, 1923.

Northern. No. 426,551. Class 6. Electric vacuum cleaning machines. The Northern Steel & Hardware Co., Ltd., 9, South Parade, Manchester. August 29th, 1923.

Draka (lettering and design). No. 438,782. Copper wire, included in Class 5. Naamlooze Vennootschap Hollandsche Draad en Kabel Fabriek, 10, Hamerstraat, Amsterdam, Holland. (J. E. Evans, Jackson & Co., 56-60, Holborn Viaduct, London, E.C.) August 29th, 1923.

For Sale.—By direction of the George Cohen & Armstrong Disposal Corporation, Messrs. Alsop & Co. will sell by auction, at the R.A.F. Depôt, West Drayton, on October 9th, and following days, insulated and other cables, electric lamps, fittings, &c.

Copper and Lead Prices.—Messrs. F. Smith & Co. report, September 11th: Copper (electrolytic): bars, £69 15s., 5s. increase; ditto ditto sheets, no change; ditto ditto wire rods, £79 15s., 5s. increase; ditto ditto h.c. wire, 9 15-16d., 1-16d. increase.

Messrs. James & Shakespeare report, September 12th: Copper bars (best selected), sheet and rod, no change; English pigiead, £26 15s., 5s. decrease.

Electrical Trade in South Africa.—According to the *South African Export Gazette* of September 6th: "The general South African market for electrical material and machinery is showing considerably more activity this year than last. The latest records to hand show imports valued at £465,966 during the first four months of the current year, as against only £308,172 in the same period of 1922, and there is evidence to prove that in the following four months, which brings us up to the end of August, buying was on an even larger scale. What the remainder of the year and the opening months of 1924 have in store, it is, of course, impossible to predict with any accuracy, but with town-lighting schemes in prospect at Wellington, and not a few other Union centres, and the continued demand for additional power facilities in the larger towns, no decline need be feared. The signs are undoubtedly all the other way, and the South African electrical goods market is as profitable a proposition to-day as it has ever been."

New Italian Company.—Under the auspices of a Franco-Italian-Spanish syndicate, a new company has lately been formed with a capital of 60,000,000 lire, and the title La Società Metropolitana di Génová, with the object of constructing and working a metropolitan electric railway in the city.

Tenders for Swedish Locomotives.—The Swedish State Railway authorities recently received tenders from the following national firms for the supply of electric locomotives for the Stockholm-Gothenburg railway:—A.S.E.A., Nya Luth and Roséns Electrical Co., the Motala Workshops Co., Nydquist & Holm, the Swedish Railway Workshops Co., Kockums Mechanical Workshop Co., and the Atlas-Diesel Co. In addition, tenders were submitted by Siemens-Schuckert and the A.E.G., the Bergmann Electricity Works Co., Brown-Boveri and Co., the Mannheim-Kafertal Machinery Works, the Oerlikon Co., of Zurich, and the Westinghouse International Electrical Co. It is stated that the lowest offer was made by Siemens-Schuckert and the A.E.G., the amount being 195,000 kronen per locomotive; the highest was at 264,000 kr. per locomotive, and was submitted by the Atlas-Diesel-Bergmann group, while the tenders of the A.S.E.A., and of three other Swedish works, reached 229,000 kr. per locomotive. After an examination of the tenders the railway authorities came to the conclusion that they were mostly too high, and in some cases the reservations made were considered unacceptable. Under the circumstances all the offers were rejected, and fresh tenders were invited to be sent in by September 12th.

Battery Works Extension.—Considerable extensions are now being made at The D.P. Battery Co.'s works at Bakewell, Derbyshire, in order to meet the demands for D.P. storage batteries. Entirely new and enlarged shops are under construction and this will enable the output to be increased considerably. We understand that the introduction by The D.P. Battery Co. of Shortfirst Charge batteries some two years ago has proved a great success. Increased facilities are also being provided in the electric vehicle department, in order to deal with the large number of orders being received for Kathanode electric vehicle batteries.

LIGHTING AND POWER NOTES.

Audenshaw.—ELECTRICITY SUPPLY.—The Urban District Council proposes to obtain an electricity supply for the district from Manchester Corporation, and a canvass is being made of the residents to ascertain the number who would be willing to take a supply.

Australia.—MURARRIE.—The Brisbane City Electric Light Co. proposes to erect a new power station at Murarrie on Brisbane River.

Aylesbury.—PROPOSED EXTENSION OF SUPPLY.—The Town Council is in communication with the Councils of Thame, Haddenham, Tring, and Wendover with regard to the extension of its mains to these places for the supply of electricity for public and private purposes.

Blackpool.—LOAN.—The General Purposes Committee is applying to the Electricity Commissioners for sanction to the borrowing of £10,000 for duplicate feeders and pilot cable between the electricity works and the southerly boundary of the borough at Squires Gate.

Boston.—PROPOSED ELECTRICITY SUPPLY.—The Town Council proposes to obtain an electricity supply for the district, and has offered the Boston and District Electric Supply Co., Ltd., a piece of land for the purpose of erecting a power station.

Bulkington.—ELECTRICITY SUPPLY.—The Urban District Council has accepted the offer of the Leicestershire and Warwickshire Electric Power Co., for public lighting. The power station will be erected on the Council's premises, and the work will be proceeded with forthwith.

Continental.—FRANCE.—M. Guiter, the promoter of the Société des Forces Motrices de la Vallée d'Argelès, who submitted in 1922 a scheme for the electrification of the Landes department, embracing a number of townships, has now put forward a larger scheme, including all the communes and, eventually, the departmental railways. The plans also comprise the harnessing of a waterfall capable of furnishing 16,000 kW. The application for a concession is now under official consideration. Meanwhile a beginning has been made with the works, which are expected to be finished within three or four years. The whole scheme is expected to cost 21,000,000 fr.

ESTHONIA.—The *Journée Industrielle* learns from Reval that a group of British capitalists investing £1,000,000 is undertaking the construction of a hydro-electric station in Esthonia for the exploitation of the Narowa Falls. The total available energy in the country amounts to 170,000 h.p., the Narowa Falls representing 90,000.—*Reuter's Trade Service* (Paris).

Dolgelly (Merioneth).—SPECIAL ORDER.—The Cambrian Electricity Supply Corporation, Ltd., has applied to the Electricity Commissioners for a Special Order authorising it to supply electricity in the district.

Doncaster.—STREET LIGHTING.—The Electricity Committee has decided to apply to the Electricity Commissioners for sanction to borrow £2,400 for main street lighting purposes.

Eastry.—OPPOSITION TO ORDER.—The Rural Council has decided not to agree to the granting of the East Kent Electricity Order, as the promoters are unable to guarantee a supply of electricity within the district on reasonable terms.

Electricity District.—WEST OF SCOTLAND.—An important conference between representatives of the various public authorities, of electricity supply companies, and of railway

companies in the West of Scotland for the purpose of determining what action should be taken in view of the Electricity Commissioners having delimited the West of Scotland Electricity District, held in Glasgow on September 7th, approved the setting-up of a Joint Advisory Committee.

Irish Free State.—Dublin.—At a recent meeting of the Corporation, dealing with a report of the Electricity and Public Lighting Committee on electricity charges, Alderman Byrne said it was recommended that application be made to the Free State Ministry of Industry and Commerce for the fixing of a maximum price of 9d. per kWh and 1s. for slot meter supply. The actual maximum price which it was proposed to charge at present was, however, 8d. per kWh. It was proposed to reduce lighting all round by 1d. per kWh, bringing the maximum rate to 8d. and the minimum to 6d. The lowest power rate would be 1½d. per kWh. A new rate of 2d. was recommended for power. For slot meters the rate proposed was 10d. per kWh, with a continuation of the meter rental charge of 5s. per quarter.

Liverpool.—Proposed Joint Electricity Board.—The Mersey Docks and Harbour Board has asked the Corporation to reconsider its decision to withdraw from the Provisional Committee for a joint Merseyside electricity authority. The chairman of the Liverpool Electricity Committee stated at a recent meeting of the Council that any scheme appropriate to Liverpool would be considered, but the Electricity Committee was safeguarding itself from misrepresentation and the burden of expenditure. The matter was referred to the Electricity Committee.

Leicester.—Special Order.—The Corporation is applying to the Electricity Commissioners for a Special Order, authorising it to extend its area of supply so as to include the Urban District of Thurmaston and certain parishes in the Urban Districts of Barrow-upon-Soar and Blaby.

Nelson.—New Plant.—The Town Council has applied to the Electricity Commissioners for permission to install a 6,000-kW turbo-generator (estimated cost £24,000) and for sanction to borrow the sum from the Unemployment Grants Committee.

Newton-le-Willows (Lancs.).—Electricity Scheme.—The Urban District Council has submitted a scheme for an electricity supply for the district to the Electricity Commissioners for approval, with a request for sanction to the borrowing of £25,000 to carry out the scheme.

Price Reductions.—Reductions in the charges for electricity have been made in the following districts:—

Turton.—Lighting: 6d. per kWh. Energy for domestic purposes: 2d. per kWh. Power: 3d. per kWh for the first 500 kWh and 2d. per kWh for all energy above this amount.

Wallasey.—Lighting: From 6d. to 5½d. per kWh. Heating: From 2d. to 1½d. per kWh.

Reigate.—Electricity Supply.—The Rural Council has decided to offer no objection to the transfer of the Banstead, Chipstead and District Electricity Order, 1923, to the South Metropolitan Electric Tramways & Lighting Co., Ltd. The Council has also decided to offer no objection to the Crawley and District Electricity Special Order, on condition that the cables are laid underground and that no overhead cables are used.

Rotherham.—Electricity in Bulk.—An agreement has been arranged between the Corporation and the Yorkshire Electric Power Co., whereby the company will receive a bulk supply of electricity for use at the Orgreave Colliery.

Stockport.—Loan Sanctioned.—The Town Council has received from the Electricity Commissioners sanction to a loan of £82,376 for electricity purposes. The Council had applied for a loan of £120,000, but the Commissioners wrote asking to be furnished with further particulars of certain items of expenditure included in the application.

Ulverston.—Electricity Supply.—The Urban District Council is applying to the Electricity Commissioners for authority to supply electricity within the urban district and the Osmotherley area.

Vancouver Island (B.C.).—Electricity Supply.—A demand has arisen on Vancouver Island for the extension of the British Columbia Electric Railway Co.'s high-pressure transmission line from the Jordan River plant. Duncan, Ladysmith, and Nanaimo are negotiating for the supply of power, as are also a number of industrial concerns along the proposed route. A decision is expected from the company at an early date, when, if favourable, work will be pushed on with all haste.—*Reuter's Trade Service* (Victoria, B.C.).

Wallasey.—Joint Electricity Scheme.—The Electricity Commissioners have written to the Electricity Committee pointing out that in view of the changed conditions during the past two and a-half years, it would be to the advantage of the Wirral authorities, including Birkenhead and Wallasey, to participate in the formation of a Joint Electricity Authority for the whole of the district. An inquiry will be held in October for the purpose of enabling the Corporation to make further representations.

Worcester.—Loan.—The Town Council has applied to the Electricity Commissioners for sanction to a loan of £7,000 in connection with the scheme for giving a bulk supply of electricity to Malvern and for supplying the village of Powick.

TRAMWAY AND RAILWAY NOTES.

Blackpool.—Loans.—The General Purposes Committee has decided that application be made to the Ministry of Transport for sanction to borrow the following amounts for tramway purposes, *viz.*:—Engineering workshops at Rigby Road, £9,000; overhead motor tower wagon, £1,354; new traction feeder, £6,475; and eight new saloon top-covered cars, £14,000.

Bolton.—Track Renewals.—The Tramways Committee proposes to relay the tramway track in Bury Road, between River Street and Hilden Street (on the outward route) and between Hilden Street and Manchester Road (on the inward route).

Bradford.—Proposed Railless Cars.—The Tramways Committee is applying to the Ministry of Transport for a Provisional Order empowering the Corporation to run railless cars or motor omnibuses on approved routes within the city.

Bromley (Kent).—L.C.C. Tramway Scheme Opposed.—The Town Council has informed the London County Council that it objects to the proposal to construct tramways in the borough. The Rural Council has received a protest from the Mottingham Parish Council against the proposal of the L.C.C. to lay a tramway through the parish, and a request that the Council shall oppose the Bill.

Continental.—Germany.—Fares on the Cologne cars are to be raised to 200,000 marks in order to avoid a suspension of services.—*The Times.*

The entire Berlin tramway service was suspended on September 9th in order to enable a new private company, which has taken over from the State authorities, to make its own arrangements for running the tramways, under new conditions. About half the services are to be abandoned, to save expenses. In spite of higher fares, the service made a deficit of 517,000,000,000 m. during the last six days.—*The Times.*

Dewsbury.—Extension of Time.—The Ministry of Transport has extended by one year the period for the completion of the tramways to Dewsbury Moor and Shaw Cross.

Doncaster.—Removal of Tramway Track.—The Town Council proposes to remove the existing tramway track on the Doncaster and Selby Road in the parish of Bentley-with-Arksey, when the County Council raises the level of the road, subject to the approval of the County Council and to the Corporation being authorised to run railless cars over the route round Arksey colliery village and to the Bentley Toll Bar.

Halifax.—Year's Working.—The report of the engineer and manager (Mr. B. Hall) on the working of the tramway undertaking for the year ended March 31st last shows a total revenue of £227,696, as compared with £226,769 in the previous year. Working expenses amounted to £178,641 (£198,292), leaving a gross profit of £49,054 (£28,477). After deducting income tax, interest, and sinking-fund charges, there was a net surplus for the year of £18,254. The result of the previous year's working was a net profit of £2,830. The amount expended on capital account during the year was £38,474, making a total of £514,953. In addition to the expenditure out of loan, £17,083 was drawn from revenue. The energy used for traction purposes over a car-mileage of 2,244,787 was 5,399,543 kWh, an average of 2.41 kWh per car mile; and the number of passengers carried during the year was 22,966,100, an increase of 2,166,440.

Railless Car System.—The total income from this source amounted to £2,186 11s. and the total expenditure was £2,186 5s. 6d., leaving a profit for the year of 5s. 6d., which has been transferred to tramway account.

Isleworth.—Track Renewal.—The long-anticipated renewal of the tramway track in conjunction with road-widening operations between Isleworth and Twickenham has been commenced by the London United Tramways, Ltd., several labour-saving devices being employed in the work. Besides an electrically-driven concrete mixer, a pneumatic road breaker is used, the compressor being electrically driven and the whole mounted on a tramcar chassis.

Lake District.—Proposed Electric Railway.—A proposal has been made to construct an electric railway through the Lake District between Windermere and Keswick, starting about half-a-mile on the Kendal side of Windermere village.

Leeds.—Railless Cars.—Under a Bill which the Corporation intends to promote in Parliament next year, powers are being sought authorising the Corporation to run railless cars or omnibuses in connection with the tramways.

Oldham.—Year's Working.—The report of the general manager of the municipal tramways (Mr. W. Chamberlain) for the year ended March 25th last states that the total income during the year was £241,652, and the working expenditure £179,572, leaving a gross surplus of £62,080. In the previous year the figures were:—Revenue, £253,883; expenditure, £200,503; and gross profit, £53,380. After debiting capital charges, &c., the result was a net profit of £18,544, as compared with £16,723 in 1921-22. Of this amount, the Borough Fund received £12,605, the balance being transferred to the reserve for renewals. Although the number of passengers carried fell from 32,402,875 to 32,140,449, the car-mileage rose from 2,460,699 to 2,608,696. The ratio of working expenditure to receipts fell from 78.97 to 74.31 per cent.

COAL MINING IN CHINA.

The Kailan Mining Administration.

The Kailan Mining Administration, whose head office is at Tientsin, controls the property of two mining companies with a paid-up capital of two millions sterling, in addition to debentures amounting to £1,200,000. The mines are situated in the Kaiping district of the Province of Chihli, and are served by the Peking-Mukden Railway.

Thirteen seams of coal have been proved. At the south-western end of the Kaiping basin, the aggregate thickness of coal is 40 to 60 feet at Tongshan Colliery; the total thickness at Machiakow Colliery reaches 60 to 80 ft., and at Linsi Colliery, at the eastern extremity, the thickness is again 40 to 50 ft. To the south and south-east, the field has not, so far, been exploited. At present the known deposits of coal in these measures down to a depth of 3,000 ft. are estimated to amount to over one thousand million tons.

Modern methods of working were first introduced in 1878 at Tongshan Mine; three large shafts have been carried to a maximum depth of 1,500 ft., and the capacity of the present equipment is from 2,500 to 3,000 tons a day. The principal engineering workshops have been established at this colliery, and are capable of turning out heavy castings, centrifugal pumps, ventilating fans, railway cars, heapstead gear, and generally all the minor engineering and fitting work required about the mines.

Machiakow Mine has a daily capacity of 2,500 tons, which will rise to 4,000 tons very shortly when the erection of the big electrical winding engine, now being carried on, is completed.

Like Machiakow, Chaokochwang Colliery, fig. 2, is comparatively new; the workings have attained a maximum depth of 1,400 ft., four shafts delivering coal to the surface. The output of this mine is at present 5,500 tons a day, but the capacity will reach 8,000 tons at the end of this year, when the new electrical winding engine is put into commission.

Fig. 2.—Chaokochwang Mine.

The Linsi Mine, figs. 1 and 5, is the main centre for the production of power. The output at Linsi is 3,500 tons a day, the capacity of the two shafts being 4,500 tons.

The Linsi power plant will be finished by the end of this year. The steam-raising plant will then comprise four Babcock & Wilcox boilers, each of 496 m² heating surface, and with one steel plate chimney 8 ft. in diameter and 60 ft. in height, fitted with one Sirocco fan driven by an electric motor of 150 h.p.; and eight Babcock & Wilcox boilers of 663 m.² heating surface, each pair having a steel chimney 8 ft. in diameter with induced-draught fans driven by electric motors of 65 h.p., and forced-draught fans driven by 30-h.p. motors. Superheaters, Green economisers, and chain-grate stokers are provided.

Fig. 1.—Linsi Mine: Heapstead and Headgear, South Pit.

There are two turbine boiler-feed pumps, each capable of feeding the eight big boilers, one of the same type capable of feeding the four small boilers, and one electrically driven Sulzer centrifugal pump. Two 6-in. "Venturi" water meters are inserted in the discharge pipes from the pumps, and two Steinmuller registering water meters having a capacity of 50,000 litres of water per hour are provided.

The generating plant includes two 3,000-kW, three-phase turbo-alternators, fig. 3, built by the Metropolitan-Vickers Electrical Co., Ltd., working at 25 cycles, 2,200 volts, 1,500 r.p.m. The circulating pump and the air and water extraction pumps are driven by small turbines. Each set is fitted with a wet air filter.

There are also two Brown, Boveri turbo-alternators of 6,000 kW each, running at 1,500 r.p.m. The steam pressure is 200 lb. per sq. in.

For each set the circulating pump, extraction pump, and delivery pump to the air ejectors are provided with

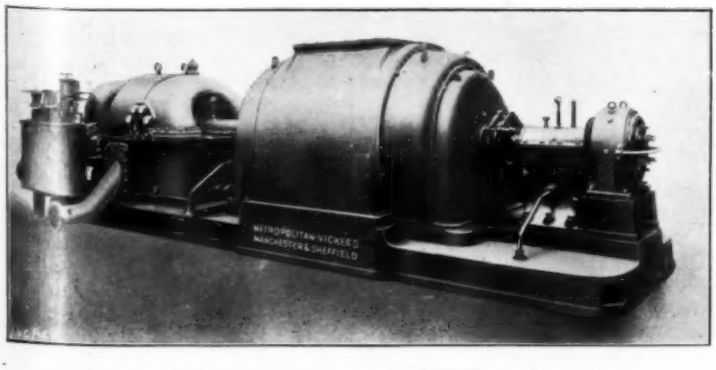


Fig. 3.—Metropolitan-Vickers 3,000-kW Turbo-Alternator, for Linsi Power Station.

duplicate drive, by a turbine exhausting into one of the stages of the main turbine, and by an electric motor. The latter does the work under normal conditions, the auxiliary turbine being automatically started in case of accident to the motor or failure of the power supply. Each turbine is provided with an air filter, the water circulation of which is effected by a small centrifugal pump and electric motor. Six Balcke cooling towers (fig. 4) are installed.

Fig. 4.—Linsi Mine: Cooling Towers.

Besides the above described machines, there are installed for the auxiliary services one motor-generator of 125 kW and two steam-driven generating sets.

The newly erected switchboard was supplied by Messrs. Brown, Boveri and Co., and comprises two main sets of busbars, to which may be connected any of the 2,200-volt generators, with remote control, automatic regulators, and automatic synchronisation of the alternators, and two distributing sets of busbars, which can be connected with either of the former as required. Each of the outgoing feeders may be connected with either set of busbars. The energy generated is distributed to the Linsi mine by 2,200-volt feeders, and to the other mines through a separate sub-station where the pressure is stepped up from 2,200 to 30,000 volts.

The Linsi sub-station, installed in a separate building, contains four 4,500-kVA air-cooled transformers, supplied by the General Electric Co., Schenectady. From the sub-station run two overhead lines on twin reinforced concrete poles, one of 3 by 30 mm.² for Linsi, Chaokochwang, Machiakow, and Tongshan mines, and the other of 3 by 40 mm.² from Linsi to Tongshan direct. There are at present in service for all the mines daily an average of about 250 electric motors and 120 transformers for the service of pumps, fans, screens, hoists, shops, &c. The main service is the pumping-out of the underground water from the four mines, this amounting to about 50 m.³ per minute in normal times and rising to 70 m.³ during or immediately after the rainy season.

The big centrifugal pumps deliver 6 m.³ per minute at an 800-ft. head; they are driven by 500-h.p. motors. All the pumps are made in the company's workshops. Power is supplied also to the Chee Hsin Cement Works, the requirements of which are expected to reach 4,000 kW in a year or two.

The company is at present erecting two big electric winding engines (one at Chaokochwang and one at Machiakow), constructed by the Ateliers de Constructions Electriques de Charleroi (fig. 6). They are capable of lifting a net load of 5.5 tons from 508 m. depth in 75 seconds. The drums are of the bicylindro-conical type, split into two separate drums to allow the stretch in the rope to be taken up. The motor of the Ward-Leonard set is to develop up to 1,383 h.p.

Fig. 5.—Linsi Mine.

Various electric hoists of 175 h.p. at a speed of 5 m. and 355 h.p. at a speed of 7.5 m. per second for lifting net loads of about 2 tons are being installed.

To step down the pressure from 30,000 volts for the normal use of the mines, there is at Chaokochwang a sub-station containing three transformers of 1,500 kVA each, at Machiakow a similar station with six transformers of 750 kVA, and at Tongshan a sub-station with four transformers of 1,500 kVA each.

Besides the main power station of Linsi, the company has at Tongshan a power house equipped with three flywheel alternators, driven by steam engines, and rated at 1,040 kW; steam is supplied by 15 Galloway boilers, with economisers and superheaters. The Tongshan power station supplies part of the requirements of the Tongshan mine, the balance coming from Linsi. Also at Machiakow there is a power station with a 50-cycle flywheel alternator rated at 1,260 kVA and driven by a steam engine; this set is able to supply energy for all the services of the Machiakow mine. At this mine all the motors driving the different machines are in duplicate, *i.e.*, one set at 25 cycles and the other at 50 cycles. Under these conditions the Machiakow mine can always run either with current from its own power station or with current derived from the Linsi station.

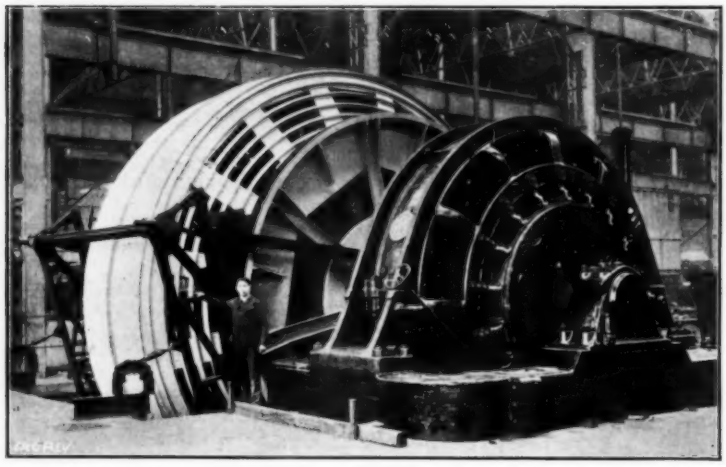


Fig. 6.—A.C.E.C. Winding Engine on Test Bed.

ELECTRICITY SUPPLY AT PETERBOROUGH.

Inauguration of Reconstructed Station.

The City of Peterborough is the business centre of a large portion of the East Midlands; it is advantageously situated for development, and particularly well served by railways. The official opening on September 6th of the reconstructed electricity generating station, in conjunction with the reorganisation of the distributing system and the extension of the area of supply, may therefore be looked upon as a landmark in the history of the city's enterprises.

It was in December, 1900, that the late Mr. J. C. Gill, in consultation with Dr. J. A. Fleming, first commenced to supply d.c. at pressures of 200 and 400 volts on a 3-wire system within the city boundary from the Albert Meadow 120-kW generating station on the bank of the River Nene. By the end of March, 1919, the plant capacity had reached 1,340 kW, the maximum demand on the undertaking being then 633 kW, the annual output one million kWh, and the number of consumers 583.

In that year the City Council decided to enlarge its undertaking in order to meet the growing demand for electricity, and a scheme was prepared in accord with the advice of Mr. W. M. Selvey, which involved the extension of the supply beyond the economical limit of the existing l.p. d.c. system; it was therefore decided to adopt an a.c., 3-phase, 50-cycle supply generated at 6,600 volts for all extensions, and to provide rotary converters to maintain the d.c. supply. The old reciprocating-engine room proved to be adequate to house the new turbo-generator plant, fig. 1, but in the case of the steam-raising plant a new boiler house was necessary. The reconstruction work was to have been carried out in three stages, as necessity arose, at estimated costs of £53,000 for the first, £97,000 for the second, and £125,000 for the third stages respectively, or a total of £275,000, including £55,100 for the provision of e.h.p. feeders and sub-stations. The present engineer and manager of the undertaking, Mr. H. A. Nevill, was appointed in July, 1920, and the proposals having met with the approval of the Electricity Commissioners, the area of supply was extended in December of the same year by the Peterborough Electricity (Extension) Order, which authorised the Corporation to furnish a supply of electricity within an area 39 times greater than that covered by its 1894 Order.

The work of modernisation was commenced in 1920, but owing to the growth of the demand for energy being even greater than had been expected, the three stages of the scheme followed immediately after one another, with the result that the whole has now been completed. The contracts for the whole of the work were entrusted to the English Electric Co., Ltd., with the Spearing Boiler Co. as sub-contractor for the boilers; Messrs. Peter Brotherhood, Ltd., of Peterborough,

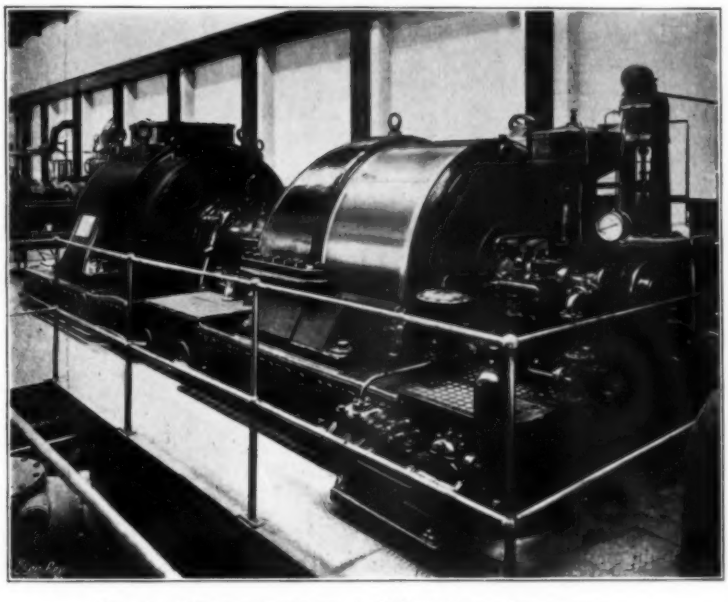


Fig. 2.—English Electric 3,000-kW Turbo-Alternator.

Fig. 1.—Interior of Engine-room.

also acted as sub-contractors for the building of the third turbine and condenser and for the main circulating-water pumps.

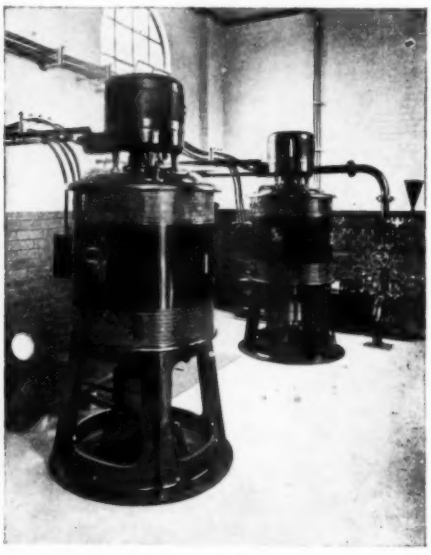


FIG 3.—ENGLISH ELECTRIC VERTICAL-SPINDLE THREE-PHASE MOTORS DRIVING CIRCULATING PUMPS.

The old engine-room foundation raft was sufficiently strong to carry the new plant, and its surface has been

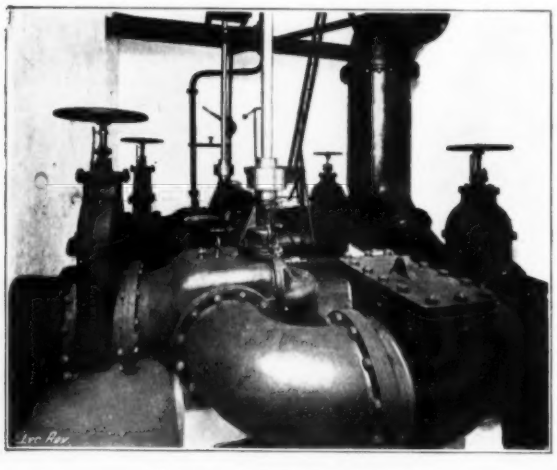


FIG. 4.—CIRCULATING PUMPS.

utilised as the floor of the new basement. The operating floor has been raised 8 ft. above the old floor to give

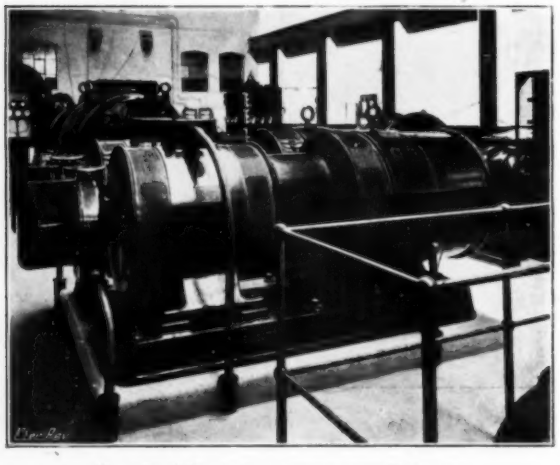


FIG. 5.—MOTOR-GENERATORS FOR TRACTION.

sufficient head room for the condensing plant, and the roof has been lifted bodily 6 ft. To carry the heavier crane installed, a series of steel stanchions has been fixed to the inside of the engine-room wall and connected at their upper ends with girders which, in turn, carry the crane rails. The battery was removed to new quarters and the old battery room converted into a cell room for e.h.p. switchgear.

The basement has been made waterproof, but in order to provide against possible floods from the river, the extraction pumps for the condensers are driven by 120-h.p. vertical-spindle 3-phase motors, fig. 3, which

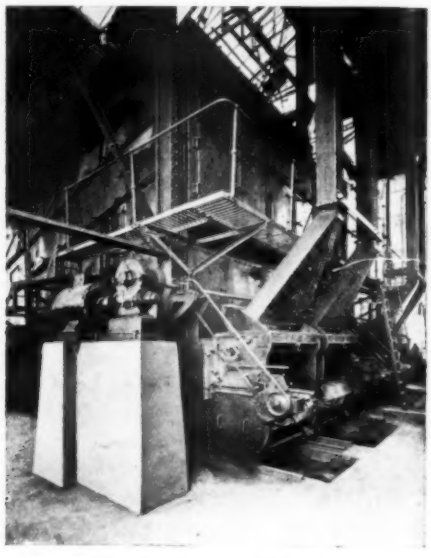


FIG. 6.—SPEARING BOILERS.

are placed above the highest recorded flood level. The whole of this work, as well as the removal of the d.c. switchgear from its position near the north wall of the engine room to the west end of the building, was carried out without interrupting the continuity of the supply from the old d.c. generating plant in the same building.

In a similar manner the old Lancashire boilers had to be kept in use for a long period in the open air dur-

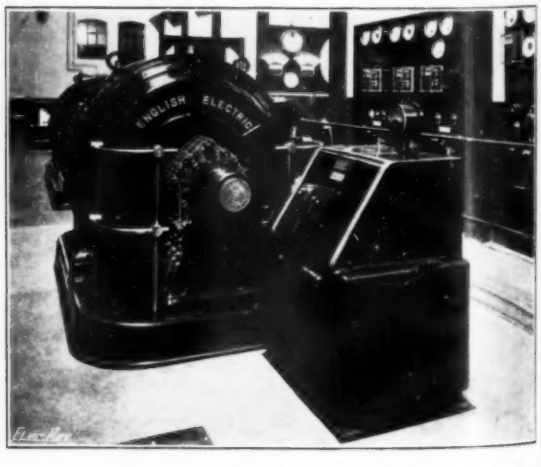


FIG. 7.—ENGLISH ELECTRIC 750-kW ROTARY CONVERTER.

ing the erection of the first half of the new boiler house. The latter is built on a reinforced-concrete raft carried on reinforced-concrete piles driven in the limestone bed under the site. It was at first intended to equip each of the four boilers with chain-grate stokers, but in February, 1923, the Committee decided to install coal-pulverising plant for Nos. 3 and 4 boilers, the unit type of pulveriser of Messrs. Simon Carves being adopted.

The equipment now installed in the turbine room consists of one 1,000-kW and two 3,000-kW turbo-alternator sets and condensing plant; one 500-kW and two 750-kW rotary converters (one of the latter is shown in fig. 7); two 100 kW a.c./d.c. motor-generators for

supplying the tramways (fig. 5); and e.h.p. switchgear and control panels.

The two larger turbo-generator sets, one of which is illustrated in fig. 2, are of the English Electric Co.'s standard design, running at a speed of 3,000 r.p.m., and are capable of withstanding an overload of 25 per cent. for two hours. The three turbines—two English Electric and one Peter Brotherhood—operate at a steam pressure of 250 lb. per sq. in., with 150 deg. F. superheat and exhaust into a vacuum of 28.5 in. The condensing plant for the two larger sets was supplied by Messrs. Cole, Marchent & Morley, Ltd.

In the boiler house there are four 25,000-lb. per hour Spearing water-tube boilers, fig. 6, with two reciprocating and one turbine-driven rotary feed pumps, each of which is capable of delivering 100,000 lb. of water per hour; the pumps were supplied by Messrs. J. P. Hall and Sons, Ltd., of Peterborough. A water-treating plant has been installed, and the boilers are provided with steel chimneys and induced-draught fans.

Coal is received in railway trucks from the L. and N.E.R. sidings and unloaded on to the dumps, from which it is transported to the coal bunkers above the boiler house by means of an automatic telpher apparatus operated electrically, and having a capacity of 15 tons per hour; the bunkers feed through chutes to the mechanical stokers and pulverisers. These items, as well as the ash plant and the construction of the boiler house itself, were carried out by the Mitchell Conveyor and Transporter Co., Ltd.

The condenser circulating-water system consists of two vertical-spindle motor-driven pumps, fig. 4, in a house near the river, fitted with control gear operated from the turbine room. Provision is made for two more pumps, and the cast-iron water mains are arranged as a siphon. With regard to the distribution system, 9.15 miles of e.h.p. feeders have been completed and sub-stations equipped on the premises of six large consumers who are taking a 6,600-volt supply. In addition, two sub-stations have been put into operation in new areas for low-pressure a.c. distribution. At the present time an additional 4.36 miles of e.h.p. cables are being provided to serve another section of the Corporation's supply area. All the cables used were supplied by Callender's Cable & Construction Co., Ltd.

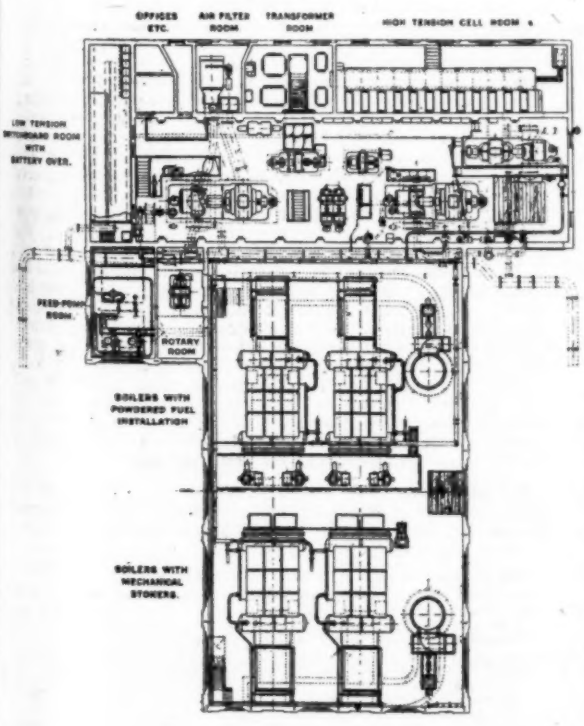


Fig. 6.—Plan of Station.

In conclusion, the following statistical table may be of interest, but it should be pointed out that the quantity sold in the current year is expected to be much greater, as indicated by the fact that the number of kWh sold during the month of July, 1923, was 124 per cent. greater than in July, 1922.

	March, 1919.	March, 1923.
Plant capacity, kW ...	1,340	7,000
Number of consumers ...	583	1,211
Maximum demand, kW ...	633	2,000
kWh sold	1,016,376	2,215,853

The total value of the contract for the reconstruction of the undertaking, excluding the mains and sub-stations, has been £250,145, but it should be explained that the final equipment includes more plant than was originally provided for.

TELEGRAPH & TELEPHONE NOTES.

France.—Telephone Service.—In the use of telephones, France comes ninth with one station for every 82 persons, which is ten times less than the United States and less than Luxemburg, Cuba and Finland. In the matter of telephone traffic and modernity of plant France is 20 years behind the United States, Sweden, Denmark and Canada. The French Government has, however, been moved to take action and proposals presented to and sanctioned by Parliament comprise a programme of big reforms to be completed in ten years, and to cost over two milliards of francs; and a thorough-going financial and administrative recasting of the post, telegraph and telephone services. In detail some of the works contemplated are: new telephone offices, 125,000,000 fr.; new postal or mixed offices, 177,000,000; furniture and apparatus, 30,000,000; rolling stock, 22,000,000; telegraphic material, 68,000,000; and telephone material, 1,719,000,000 fr. Seven new telephone trunk lines are to be erected, including one from Paris to London, while automatic exchanges are to be widely installed.

French Enterprise Abroad.—It is stated in the French newspapers that an Italian branch of the Compagnie Générale de Télégraphie sans Fil has just obtained from the Italian Government a concession for the whole of the public services in wireless telegraphy in Italy. This branch has been formed under the title of the Radio-Italie with a share capital of 1,000,000 lire, which is now to be increased to 50,000,000 lire. The company will receive from the Italian Government all the stations which the latter has already established and will also erect new stations. The Italian Government will participate in the profits of the Radio-Italie.

Supplementing the information published a week ago regarding the agreement between the Compagnie Générale de Télégraphie sans Fil and the Russian Radio-Electric Trust, it is announced that the former will co-operate technically with the latter in the establishment of wireless stations in Russia and in the manufacture of apparatus in that country. In return the French company will receive a share of the profits of the Russian undertaking.

London.—County Hall.—On Saturday last the telephone service at the London County Hall was changed over from manual to automatic operation. The new exchange is equipped for 700 extension telephones, of which 650 will work automatically and the remainder manually. The ultimate capacity of the board is 900 stations.

RADIO-TELEGRAPHY AND TELEPHONY.

South Africa.—Radio-Broadcasting.—According to the Durban correspondent of *The Times Trade and Engineering Supplement*, a number of regulations for wireless broadcasting have been drawn up by the Government. It is provided that any person may apply to the Postmaster-General for a licence to establish a service of broadcasting by wireless telephony. The licence will cover a period of five years and provisions are made for renewal. It is expected that several broadcasting stations will be erected. The Durban Municipality has already taken preliminary steps, and it is anticipated that the Durban area will have its own station before the end of the year.

Radio-Broadcasting.—Bournemouth Station.—We understand that Mr. B. Fryer, director of the Newcastle-on-Tyne station, is coming south to take charge of the new station to be established at Bournemouth.

Australia.—Broadcasting.—A convention called together by the Postmaster-General of the Commonwealth has drawn up recommendations with regard to regulations for broadcasting. At the recent State Conference at Hawkesbury College, Sydney, the Amalgamated Wireless of Australia, Ltd., transmitted a complete musical programme. The receiving end was organised by the British General Electric Co., Ltd., a "Gecophone" set being installed.

CONTRACTS OPEN AND CLOSED.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

OPEN.

Aberdeen.—September 17th. Electricity Department. Coal-handling plant. (August 31st.)

Abersychan.—September 17th. Urban District Council. Carrying out certain electric lighting work within the urban district. (September 7th.)

Australia.—MELBOURNE (VICTORIA).—October 6th. Electricity Commissioners. 22,000-V insulators.*

MELBOURNE.—October 24th. Victorian Government Railways. Electric hoists.*

ADELAIDE (SOUTH AUSTRALIA).—October 30th. S.A. Harbours Board. Four 7-ton electric travelling coal-unloading cranes. Specifications from the offices of the Board, Victoria Square, Adelaide.

Belgium.—October 31st. Belgian Post and Telegraph authorities, La Salle Madeleine, Brussels. Switchboards and other apparatus for the telephone exchange in Mons. Particulars, 64 fr. (Cahier des Charges Special No. 734), from 15, Rue des Augustins, Brussels.

GHENT.—October 27th. Municipal authorities. Eight electrically-operated cranes for the Ghent docks.

Chile.—The Chilean State Railways are calling for bids for the installation of signals to be used on the Santiago-Valparaiso electric line, and for telephones for the southern system of railways. The installation will be in charge of a British engineer who has been engaged specially for this purpose by the head of the State Railway Department. The whole of the railway signal, telegraph, and telephone offices are under the charge of this official, who is also empowered to indent for all material and equipment required.—*Reuter's Trade Service.*

Croydon.—September 27th. Board of Guardians. Six months' supplies of electrical appliances. Mr. N. P. Walker, Clerk to the Guardians, Mayday Road, Thornton Heath.

Dundee.—Town Council. 200 tons of steel tramway rails, B.S.S. No. 7. Particulars from City Engineer.

Formby.—October 1st. Urban District Council. H.p. feeder cable, l.p. service cables, feeders and tee boxes, lamp standards, sub-station equipment, h.p. and l.p. switchgear. (See this issue.)

Ilford.—September 25th. Electricity Department. E.h.p. cable. (August 31st.)

Leicester.—Electricity Department. Four water-tube boiler equipments, complete with superheaters, economisers, pipework, &c. (September 7th.)

London.—POST OFFICE STORES DEPARTMENT.—September 24th. Supply of Swedish, Norwegian, Finnish, or Baltic red fir and home-grown larch or Scots fir telegraph poles. The Controller, Post Office Stores Department, 17-19, Bedford Street, W.C.2.

INDIA STORE DEPARTMENT.—September 21st. Lead-sheathed cable. (September 7th.)

H.M. OFFICE OF WORKS.—September 21st. Supply of incandescent electric lamps. (September 7th.)

October 3rd. Electric wiring in steel conduits at the New Science Museum, South Kensington, S.W. (See this issue.)

LONDON COUNTY COUNCIL.—October 15th. One 15,000-kW steam turbo-alternator and condensing plant for the Tramways Department. (See this issue.)

METROPOLITAN ASYLUMS BOARD.—October 10th. Electric lighting installation in the old East Cliff House at Princess Mary's Hospital, Margate. (September 7th.)

Lochgelly (Fife).—September 17th. Town Council. Electric lighting installation in connection with the housing scheme. Mr. A. D. Haxton, architect, 3, High Street, Leven.

Maidstone.—September 21st. West Kent General Hospital. Electric lighting installation, Marsham Street. Ruck and Smith, architects, 86, Week Street.

Manchester.—September 29th. Waterworks Committee. Electric motors, with speed-reduction gear, transformer and converting plant, cables, wiring, &c., in connection with the driving of two sets of reciprocating hydraulic pumps. (September 7th.)

Motherwell and Wishaw.—Burgh Council. Electric lighting installation (50 houses). Schedules from Town Clerk, Motherwell.

Newcastle-under-Lyme.—September 21st. Electricity Department. One 250-kVA transformer. (See this issue.)

New Zealand.—WELLINGTON.—October 31st. Post and Telegraph Department. 30,000 dry cells for telephones.*

Salford.—September 24th. Electricity Department. Cooling towers, pumping plant, and pipework at Agecroft power station. (September 7th).

September 21st. Corporation Tramways.—Six months' supplies of miscellaneous stores. General manager, 32, Blackfriars Street, Salford.

Swinton and Pendlebury.—September 29th. Electricity Department. 300-kW rotary converter, with switchgear. (See this issue.)

Uruguay.—MONTEVIDEO.—October 25th. State Electricity Works. 130,000 metres of electrolytic-tinned copper wire.* November 1st. 35,500 metal-filament electric lamps.*

Uxbridge.—September 18th. Urban District Council. Electrically-driven turbine pump, electric motor and recording meter. Mr. W. L. Eves, Council engineer, 54, High Street, Uxbridge.

Walsall.—October 10th. Electricity Supply Committee. Two boiler units complete with superheaters, economisers, steel chimneys, feed pump, pipe work and auxiliaries. (See this issue.)

Warrington. — October 1st. Electricity Department. Motor-driven air compressor. (September 7th.)

September 18th. Sanitary Works Committee. Electric vehicle battery-charging plant. (September 7th.)

Windsor. — September 24th. Board of Guardians. Electric lighting installation at the Windsor Poor Law Institution. Mr. W. W. Nobbs, 50, Fairhead Gardens, London, N.W.

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

CLOSED.

Australia.—SYDNEY.—City Council. Accepted:—

H.d. bare copper cable (£27,367).—Wm. Adams & Co., Ltd.
15,000 25-amp. house service fuse boxes (£3,250).—Laurence & Hanson Electrical Co., Ltd.
Protective apparatus for generating end of parallel feeders for Pyrmont power house (£1,750).—Ferguson, Pailin, Ltd.
Vacuum tungsten and carbon-filament lamps (sections 2 and 3) (£3,131).—Laurence & Hanson Electrical Co., Ltd.

Water Supply and Sewerage Board. Accepted:—

Five transformers, with spares (£1,267).—Siemens Bros. & Co., Ltd.

BRISBANE.—Tramways Trust.—The Trust has accepted local tenders for the construction of 10 car bodies at £545 each. Arrangements have been made with the tenderers (Messrs. G. F. Sewell) for the bogies and (the English Electric Co.) for the motors.

NEW SOUTH WALES. — Public Works Department. Accepted:—

Two electrically-operated goods lifts at the Government Printing Office (£1,200).—Waygood-Otis (Aust.), Ltd.

Bolton.—Electricity Committee. Accepted:—

Alterations to Spa Road sub-station.—J. Byrom, Ltd.

Brazil.—Orders for new equipment totalling about $1,000,000, for electrifying 35 additional miles of the Paulista Railway, Brazil, have just been placed with the International General Electric Co. This extension constitutes part of the extra portion contemplated when the first contract with the International General Electric Co. was closed in 1920, providing for 28 miles of double track electrification, and brings the total electrified mileage up to 63 miles, starting at Jundiahy and extending north to Tatu. Included in the order just announced are five 62-ton 3,000-volt d.c. switching locomotives, a complete sub-station of 4,500-kW ultimate capacity, with motor generator sets, step-down transformers, switchboards, switchgear, and other auxiliary equipment and overhead line material and transmission for the extension. The original contract called for 12 electric locomotives (eight freight and four passenger), a 4,500-kW sub-station, and overhead and transmission for the first 28 miles. This equipment went into service about October, 1921. It runs from Jundiahy to Campinas. The portion already electrified has indicated substantial savings, while, with the completion of the extension, more than double the tonnage formerly handled is expected to be hauled with ease. The Paulista is the most important railroad in South America to adopt the direct-current system for electrification. Power is being supplied at 88,000 volts, 60 cycles, by the Sao Paulo Light and Power Co., which will be converted at the sub-station for train operation.

Canada.—MONTREAL.—A contract for the erection of gas plant, at a cost of £100,000, for the Montreal Light, Heat and Power Co., has been placed with Messrs. Ashmore, Benson, Pease & Co., Ltd., of Stockton-on-Tees.

Doncaster.—Town Council. Accepted:—

1,250-kW rotary-converter and switchgear (£6,020) and street lamp fittings (£212).—General Electric Co., Ltd.
Cables (£774).—Callender's Cable & Construction Co., Ltd.
Street lamp standards (£469).—British Mannesman Tube Co., Ltd.

Dublin.—Electricity Committee. Transformer kiosk:—

Hughes & Ellison	£136
Thermotank Eng. Co., Ltd.	138
Humphreys, Ltd.	148
Geo. Watt, Ltd.	155

The Committee states that Messrs. Watt's price (which is 15 per cent. higher than the lowest offer) is for a kiosk manufactured in Dublin, but, as the greater portion of the cost will be spent on wages, it considers that the order should be placed locally, and recommends the acceptance of the tender of Messrs. Geo. Watt, Ltd.

Thirteen tenders were received for the supply of electricity meters for a period of one year. For single-phase meters (and three-phase meters) the lowest tender was that of the Dutch Ijaria Co., Amsterdam. For slot meters, the lowest tender was that of the A.E.G., of Berlin, who had this contract last year. The acceptance of the tenders of the two firms mentioned is recommended by the Committee.—*Irish Builder and Engineer.*

Grimsby.—The Electricity Committee, in considering tenders for new turbines, alternators, and condensing plant, turned down offers sent in by foreign firms. A British firm was also crossed off the list on account of not being on the King's Roll in connection with the employment of ex-Service men.

India.—Great Peninsular Railway electrification.—Messrs. Cammell, Laird & Co., Ltd., have received an important order from the Great Indian Peninsular Railway for the supply of 77 motor and trailer coaches in connection with their scheme for the electrification of the Bombay suburban lines. The new coaches will be similar in design to those recently constructed by the firm for the same railway.

Leeds.—The City Council, at its meeting on September 5th, approved the Electricity Committee's action in placing the contract for the turbine and alternator, at £31,470, with the British Thomson-Houston Co., Ltd.

London.—Metropolitan Asylums Board.—Installation of synchronised clocks at the Tooting Bec Mental Hospital extension:—

G. E. Taylor & Co. (Recommended.)	**£197**
Lund Bros. & Co.	266
Toy & Winslow	235
Synchronome Co., Ltd.	248
T. Clarke & Co., Ltd.	255
Electrical Contracts and Maintenance Co., Ltd.	280
Buchanan & Curwen	340

Londonderry.—Corporation. Accepted:—
New boiler, &c., and foundations at the electric supply station (£2,130).—Robt. Boyd & Co.—*Irish Builder and Engineer.*

Lytham-St. Annes.—Town Council. Accepted:—
E.h.p. main and pilot cables from Squire's Gate to the St. Annes electricity station.—Siemens Bros. & Co., Ltd.

Wimbledon.—Corporation. Accepted:—
12 months' supply of "Utility" combined limiters and fuse boxes.—Electrical Utilities, Ltd.

FORTHCOMING EVENTS.

Shipping, Engineering, and Machinery Exhibition.—Open until September 22nd.

British Association for the Advancement of Science.—September 12th to September 19th. At Liverpool. Annual meeting.

Institution of the Rubber Industry.—Monday, September 17th. At the Engineers' Club, London. At 8 p.m. Paper on "Rubber Floors and Rubber Roadways," by Mr. E. J. Edwards.

Iron and Steel Institute.—Monday and Tuesday, September 17th and 18th. At Milan. Autumn meeting.

Institution of Electrical Engineers.—Friday, September 21st. Visit to the International Shipping, Engineering and Machinery Exhibition at Olympia, W. Reception 4.30 p.m.

THE "ELECTRICAL REVIEW" SERVICE DEPARTMENT.

Enquiries for information must be accompanied by a stamped addressed envelope.

We should be glad if any reader could advise us of the names and addresses of the makers of:—

Ripoflex.
Direct lighting system shades.
M.P. (Multi-path) lightning arrester.

NOTES.

Summer Time.—It is officially notified that Summer Time will cease and normal time will be restored at three a.m. (Summer Time) in the morning of Sunday next, September 16th, when all clocks should be put back to two a.m.

Educational.—Technical College, Bradford.—Full-time (day) courses for students wishing to enter for the degree examinations of the London University are arranged in electrical, mechanical and civil engineering, &c. Full particulars and prospectuses can be obtained from the Principal at the College. (See our advertisement pages to-day.)

Northampton Polytechnic Institute.—We have received a copy of a publication setting forth the arrangements for evening classes during the 1923-24 session. The courses are eminently practical and the Institute is well equipped for the purpose.

University College (University of London).—The Faculty of Engineering has issued its prospectus for the Session 1923-24, containing full details of courses, tutorial staff, &c.

Birmingham Municipal Technical School.—An extensive programme of day and evening trade classes has been arranged for 1923-24. As to the evening school, classes in the more important branches of electrical engineering have been grouped to form a well-defined series of courses extending in some cases over five or six sessions. Briefly, they may be referred to under the following groups: Electrical technology; electrical trades; and radio-telegraphy and kindred subjects. Under the first group are included a graduated series of courses embracing all the fundamental principles of electrical engineering.

Borough Polytechnic Institute.—Electrical Engineering and Physics Department, Session 1923-24.—The day and evening courses commence on Monday, September 24th. Prospectuses and full particulars can be obtained from the Principal, Mr. J. W. Bispham. (See our advertisement pages to-day.)

Gas v. Electricity.—There were frequent references to the competition of gas with electricity when the North British Association of Gas Managers held their annual general meeting at Stirling last week. Mr. James Bell, Dumbarton, read a paper entitled "The Conservation of the Lighting Load." He said if they continued indefinitely in their *rôle* of passive resistance to the encroachments of their competitors, it was not too pessimistic to prophesy that in certain departments of lighting gas would ultimately be superseded. Once electricity was installed for one purpose, where was their protection from its further aggressions? Their competitors could the more easily effect other conquests once they were established. Mr. David Fulton, Helensburgh (the secretary), said there seemed to be an idea in the minds of some people that when a man substituted electricity for gas for lighting it was because he was dissatisfied with gas. That was not the case at all. He put in electricity because it was the fashion to do so. In fighting electricity the main point to consider was that they should give a good supply of gas of regular composition, and at a regulated pressure.

Automatic Train Control.—Results of tests of an automatic train control system, under practical operating conditions, which have been conducted for several weeks on the Lewistown branch of the Pennsylvania Railroad, between Lewistown Junction and Sunbury, Pa., were announced on August 1st and have been very encouraging. Nearly a year was occupied in designing and trying out the necessary apparatus. The system has been in operation throughout the entire Lewistown branch since July 11th, and the movements of all trains, both freight and passenger, have been subject to its control. This object is accomplished by a combination of electrical, pneumatic and mechanical devices applied both to the track and to the locomotives. Protective track sections of any length, suited to local operating conditions, may be established. In the case of the Lewistown branch the sections average about one mile in length. The appliances are practically the same as those used in the existing visual block signal systems. Every engine is equipped with electrical apparatus which, without actually touching the rail, picks up the current from the track by induction. This current, after being "stepped up" to a sufficient power, performs two functions. One is to operate the cab signals, which are three in number. The other is to operate the air brakes if another train is approached too closely, or proper rates of speed are exceeded, or in the event of an open switch. These functions are performed without any action being required on the part of the engineer or fireman.—*Railway Review.*

The Lighting of the New "Tivoli."—On Thursday of last week the new "Tivoli" kinema, situated in the Strand, was formally opened to the public. It is a well-designed building, with large seating accommodation, and the lighting presented a problem on account of the overhanging galleries and domed roof. The General Electric Co., Ltd., in conjunction with the architect (Mr. Bertie Crewe) drew up a scheme of illumination, and this was successfully carried out by the Berkeley Electrical Engineering Co. The exterior of the building is illuminated by means of 24 G.E.C. flood lights, 12 equipped with 500-W Osram gasfilled lamps, and the other half with 200-W lamps. These are mounted on ornamental bronze brackets and are hidden by bronze screens, which enhance the appearance of the façade. The interior lighting is carried out by means of concealed lamps, with the sole exception of the "exit" signs. The principal part of the illumination is derived from the domed ceiling. This consists of a main central dome 54 ft. in diameter flanked by six 16-ft. diameter domes. Behind a moulded cornice round each dome is concealed a row of Osram lamps arranged in three circuits and coloured amber, blue, and rose respectively. Each circuit is controlled by a dimmer and the switching is so arranged that the colours may be used independently or blended together in numerous combinations. A similar effect is obtained in the octagonal ceiling panels fitted on the underside of the gallery and balcony.

Additional illumination is obtained in various parts of the house by amber-coloured panels let into the walls. A number of G.E.C. projectors with colour-sprayed gasfilled lamps are also sunk flush in the front of the gallery to illuminate the

proscenium arch. The dome lighting is certainly very effective, but the practice of suddenly changing the colour of the lighting in the auditorium to "go" with the films, if not carried out very carefully, is apt to be somewhat disconcerting. A great deal depends upon the operator, who is not in a position to observe the effects properly, but in sympathetic hands the scheme should be quite successful.

Inns of Court O.T.C.—The Inns of Court Officers Training Corps (known as The Devil's Own) has produced a very complete roll of honour, containing, as far as possible, the name, address, and record of every one who joined the Corps from the commencement to the end of the late war. The compilation and printing of a work of this kind has taken a very long time, and for this reason the Corps has lost direct personal touch with many of the gentlemen who were in its ranks during its effective period, from 1914 to 1918. In order to reach them the officer commanding asks us to state that the price is 10s., and copies of the book can be obtained from him at the Corps Headquarters, 10, Stone Buildings, Lincoln's Inn, W.C.2, or through local newsagents.

Industrial Welfare.—The fourth annual lecture conference of the Industrial Welfare Society will be held at Balliol College, Oxford, from to-day, Friday, until September 19th. The opening address will be delivered this evening by Mr. W. L. Hichens. The programme of arrangements includes the following:—Lecture on "Modern Factory Administration," by Dr. A. D. Denning; practical demonstration in "Industrial Psychology," by Miss May Smith; lecture on "The Romance of the Factory Acts," by Miss Constance Smith; address on "The Ethical Bases of Welfare," by Dr. Marion Phillips; instructional debate (chairman: Mr. M. C. Hollis, president, Oxford Union); lecture on "Thrift Schemes in Industry," by Sir William Schooling; address on "Welfare Possibilities," by Mr. Eldred Hallas; short papers by supervisors, "Indoor Leisure Activities," Miss O. M. Forbes, "Hobbies," Mr. James Smith, "Three Years in a Mining Area," Mr. W. R. Evans; lecture on "Training the Young Worker," by Dr. H. Schofield.

Canada and the World Power Conference.—The World Power Conference, to which reference has been made in these pages on several occasions in articles relating to the British Empire Exhibition, is to be held at Wembley during July next. The object of the Conference, which is being arranged by the British Electrical and Allied Manufacturers' Association, has been explained already. In response to the invitation for Canadian participation, the Hon. Charles Stewart, Minister of the Interior, sent Mr. J. B. Challies, his Director of Water Power, to London to confer with the British authorities with a view to having the Dominion's co-operation made both adequate to Canada's unique achievements in hydro-electric matters, and acceptable to the plans of the British Committee. Important conferences with the British Committee in London, and with the French Committee in Paris, at which representatives of other European countries were in attendance, have just been concluded, as a result of which a mutually satisfactory basis for the First World Power Conference has been agreed to by all the principal countries concerned, including Great Britain, France, Switzerland, Italy, Belgium, Spain, Norway and Sweden, the United States and Canada. Germany, Austria, and Russia have not yet been invited to the Conference. The Dominion's participation in the Conference in July, 1924, will, as a result of the Hon. Charles Stewart's active interest, prove commensurate with the part Canadian enterprise has already played in the development of this "Age of Power." It is understood that the Director of Water Power is returning to Canada immediately to report the results of his conferences to the Minister of the Interior, following which a Canadian National Committee, representative of all the agencies concerned with power production throughout the Dominion—governmental, co-operate and private—will be constituted, this committee to have responsible charge, under the direction of the Minister of the Interior, for all the arrangements incidental to Canadian participation.

The American Electrochemical Society.—On September 27th-29th the autumn meeting of the American Electrochemical Society will be held at Dayton, Ohio. The programme includes a symposium on the electrochemistry of gaseous conduction—a matter which is of increasing importance to the electrical industries. There will also be discussions on electric furnace brass foundry practice, electro-deposition, organic electrochemistry, and the utilisation of chlorine gas.

Fatalities.—At Hindsford Foundry, Bolton, on September 5th, Richard Pearson (39), of Horwich, was killed by electric shock. He was manipulating an electric crane during a casting operation when there was a short circuit. Artificial respiration was tried in vain. Two other workmen suffered from severe shock and were conveyed home.

At an inquest in Dublin into the death of Bernard Phillips, aged 36, electrical engineer, who was killed while at work in a shop in Parnell Street, a verdict of "death from shock, due to an error of judgment," was returned. It appeared that deceased was taking down a temporary circuit in order to put up a permanent one, and witnesses expressed the belief that he must have taken hold of two "live" wires in mistake for "dead" ones.

Appointments Vacant.—Telegraph foreman (£440), for the Posts and Telegraph Department of the Government of Nigeria; plumber-jointer, for the Stepney Borough Council electricity department; charge-hand, for the Sidmouth Urban District Council electricity department; executive engineer (electrical and wireless, £800+) for the Government of Hong-Kong. (See our advertisement columns to-day.)

A Large Automatic Motor-generator Set.—The Union Electric Light & Power Co., of St. Louis, has ordered from the Westinghouse Electric & Manufacturing Co. a three-unit 3,750-kW automatic motor-generator set, the largest such set yet built. All the parts of the machine are standard and have been made for manual operation, but complete automatic operation has heretofore been used only with smaller machines. The set will be used to supply current to the Edison system of the company in the "downtown" districts.

The set consists of a synchronous motor and two 1,875-kW generators, one mounted on each side of the motor and all mounted on the same bed-plate. The a.c. supply is at 13,200 volts, 3-phase, 60 cycles, and the motor is wound for this voltage. The generators are for two-wire operation at 250 volts, d.c.; excitation for the motor, and the two generators will be supplied from a direct-connected exciter. The two generators will be connected in parallel, and will be operated as a single unit.

Included in the automatic switching equipment is a constant-voltage regulator, the elements of which will be connected to pressure wires extending from some point in the Edison system. The device will operate to maintain constant voltage at this point up to the load at which the continuous rating of the generator is exceeded, when the regulation of the machine voltage is taken over by a constant-current regulator, which will function to maintain constant current by controlling the shunt field excitation.

The generators are of the fully compensated shunt-wound type, no series field whatever being provided. As is the case with the smaller motor-generators now in automatic operation, the set will be started by the closing of the contacts of a contact-making voltmeter when the voltage at the distribution centre falls to a predetermined value. Reduced voltage for starting the synchronous motor will be supplied from auto-transformers. The sequence for the various starting operations will be the same as that used in manual switching. A differential voltage regulator will operate to parallel the terminal voltage of the generator with that of the bus bars before the generator is connected to the load. The separate excitation of the generators will make it possible for the voltage to be reduced to zero if necessary, to pick up a dead system. Since the two generators of the set will operate in dead parallel, provision is made for proper division of the load by means of a motor-operated three-point rheostat connected in series with the shunt field windings. This rheostat is controlled by a differential current regulator, one of its two operating elements being connected to a current shunt on each of the generators.

Canada's Loss of Water Power.—That an annual loss of $21,000,000 is being sustained by the people of Canada through the diversion of 300,000 h.p. from the Great Lakes system by the Chicago Sanitary District officials is charged by Sir Adam Beck, chairman of the Hydro-Electric Power Commission of Ontario, according to a Toronto dispatch. The Chicago Sanitary District takes from 8,000 cu. ft. to 10,000 cu. ft. of water per second for diluting its sewage so as to make it inoffensive and for the purpose of supplying electric light and power. Officials of the Chicago Sanitary District, in a recent tour of the Canadian lake cities, argued that the diversion of the water did not affect the Canadian interests, and that they were prepared to install regulatory water works costing $7,500,000 in the Niagara River below Buffalo, and in the St. Lawrence River at Gallops Rapids.

Sir Adam asserted that the amount of water diverted at times equalled the quantity which passes over the American Falls at Niagara.—*Electrical World.*

The Corrosion of Metals.—A paper on "Chemical Character of Corrosion," was read by Mr. Ulick R. Evans, M.A., at the autumn meeting of the Institute of Metals, in Manchester, on Wednesday last. Experiments were described which indicated that the corrosion of metals was mainly—probably entirely—electrochemical in character. There were two main types. The type accompanied by evolution of hydrogen gas was characteristic of reactive metals placed in acid solutions, but the rate varied greatly with the degree of purity of the metal. Where this type was impossible slower corrosion could take place at a rate determined by the diffusion of oxygen to the metal, and comparatively independent of the purity. When a metal was immersed in a solution of potassium chloride one could observe the production of alkali at the cathodic portions, the production of the chloride of the metal at the anodic portions, and the precipitation of hydroxide where these met. The electric current could be trapped and measured, and was found (by applying Faraday's law) to account for the greater part of the corrosion actually observed. Generally the cathodic areas were those to which air had free access, whilst the anodic areas were those protected from aeration. It was significant that corrosion usually proceeded

most rapidly at the comparatively "unaerated" places, hence the intense corrosion observed in "pits" and over areas covered up by porous corrosion products.

Electricity for Hatching Eggs.—An electrically-heated 31,000-egg hatchery is being successfully operated by Sam H. Moore & Son, of Corvallis, Ore. This is the largest electrical equipment of the kind in the West, and the full capacity, which is 100,000 eggs, may be increased 100 per cent. by double-decking the incubators.—*Electrical World.*

Cohesion of Copper Wire.—A series of experiments on copper wire was described by Mr. Douglas H. Ingall, M.Sc., at the autumn meeting of the Institute of Metals. Five samples of wire were used, representing soft annealed and four degrees of cold work given by 25, 40, 50 and 75 per cent. reduction of area by drawing. Each sample of cold-worked wire was obtained by drawing in one pass from the next thicker wire. The cohesion at elevated temperatures was determined by placing given loads on the wire at atmospheric temperature, heating the wire, and determining the temperature at which it broke. All the samples gave similar graphs (plotting cohesion against temperature) in which with rise of temperature the cohesion decreased along a straight line to a constant critical temperature of 350 deg. C., beyond which the cohesion was represented by a sharply descending curve. The equations to the straight lines $c=a-b\tau$ and to the curves $\tau c=k$ (where c=cohesion and τ=temperature) showed that the percentage increase of the constant b and the percentage decrease of the constant n were represented by the corresponding percentage reductions for any given cold worked wire, with the exception of constant n in the 75 per cent. reduced wire. Fractures above the critical inflection temperature of 350 deg. C. were brittle in character and intergranular; at the lower temperatures they were normal. At the critical inflection temperature the material was comparatively extremely fragile.

44-kV Underground Cables in America.—Demands on the Westchester Lighting Co. for energy have grown so rapidly during the last few years that the 13,200-volt network fed from the Sherman Creek station of the United Electric Light & Power Co. would have become inadequate this year if plans had not been laid in the fall of 1921 to cope with the situation. Raising the existing voltage to 22,000 volts would not have provided adequate service long enough to justify the expense of the change-over. However, it was ascertained that the provision of a 44,000-volt loop could be justified as to expense, but the plan involved the installation of 44,000-volt underground cables for the first time in America. It was decided to begin by installing two 44,000-volt cable feeders between Sherman Creek station and New Rochelle, with the necessary step-up and step-down sub-stations and of sufficient capacity to care for the estimated loads for a period of 15 years. Six single-conductor, 500,000-circ.mil cables will be required, and they will be laid in underground ducts already installed between the Sherman Creek station and the New York City line. In the spring of 1922 construction was started on a subway to contain nine 4-in. ducts from the New York City line to a point near the Mount Vernon-Pelham line where three ducts for 13,200-volt cables were added, making twelve 4-in. ducts from this point to the step-down sub-station to be provided at the company's generating station in New Rochelle. The route covered approximately a total of 250,000 duct-feet. The route was north on Manhattan Island, across the Harlem River in submarine cables and through the Bronx to Pulham. The total length of cable was approximately 66½ miles, made up of two feeders of three cables each, and all the cable had 20/32-in. paper insulation with ⅛-in. lead cover, and it was supplied by the Safety and Habirshaw companies, so that each feeder would be of one make of cable only. Cable delivery was started in the autumn of 1922, but severe weather conditions prevented installation during the winter, which work was done by the United Company. Using two cable gangs with gas trucks, an average of 30,000 ft. of cable was installed per week.

The crossing of the Harlem River was provided for by special submarine cables, lead-covered, jute-served, steel-wire-armoured and jute-served over all. The insulation on each cable was increased to 24/32-in. paper. Precautions were taken in laying on the armour wire to prevent adjacent strands touching, so as to minimise the loss due to flux interleakage and sheath currents.

The ducts were selected so that the three cables of one feeder formed a right-angle triangle with a spacing of 5-in.-6 in. on the sides and 7 in.-9 in. on the hypotenuse.

The existing subway line from the east bank of the Harlem River is composed of iron pipes under the New York Central Railroad tracks. In order to make use of vacant pipes on the run and still avoid the heavy loss due to the magnetic effect of the iron, the following expedient was resorted to:—

A copper-bond cable was installed with each single-conductor cable and the ends bonded together. This combination acted like a current transformer, each bond cable carrying approximately the same current as the line cable. The flux density in the iron was negligible and the effective copper loss double that of cable alone, compared to fifteen times without the bonding. The conductors are joined by a standard connector with bevelled edges, the mill insulation is pencilled down, and the insulation built up to its level with black cambric tape. The joint is then wrapped with paper strip tapering in width so as to form a tube, when tightened up, of 10/32-in. wall. The outside dimensions are 26 in. long and 4 in. in diameter. The joint is filled with petrolatum of the same grade as that used to impregnate the cable.

Cambric tape was used because of its mechanical qualities, not its dielectric strength. It is possible to wind on the cambric much tighter than paper tape of the same width. The result is the reduction of entrapped air, especially along the pencilling. Another point in favour of cambric is the higher permittivity, resulting in a grading effect, distributing the stress throughout the joint.

The paper tube was adopted because of the fact that it could be wound tightly on the cable, while a solid tube of equal insulating value would have to be larger in diameter than the cable and the space between the cable and the tube might not be completely filled with compound, causing ionisation of the entrapped air. This joint requires about four hours' time to make, and the work of splicing was undertaken at the rate of three joints per day per man.—*Electrical World.*

Standardisation in China.—The electricity supply industry in China being in its very early infancy compared with that of most other countries, it presents a unique opportunity for taking advantage of the pioneer work done in other countries to ensure its development on sound economical lines. A paper on "Standardisation and the Urgent Need for its Application to the Electric Power Supply Industry in China," read before the Engineering Society of China by Mr. E. A. Mills, A.M.I.E.E., a senior member of the staff of the Shanghai municipal electricity undertaking, indicates that engineers in that country are alive to the advantages and necessity of standardisation. According to the *Far Eastern Review*, the author emphasised the importance of adopting standardisation, not only in the power station and the distributing system but also in the consumers' premises—whether large or small. Without exception, the difficulties to be met are probably greater in China than in any other country in the world. Not being primarily an engineering nation, practically all her machinery and electrical apparatus is imported; consequently, uniformity is not the natural tendency, and until standardisation is universally adopted by all the manufacturing nations of the world it is essential that those engineers who are responsible for the expansion of the industry in China guide its progress so that the maximum efficiency will always result, and to obtain this, it is necessary to take a long view and keep in mind the magnitude to which it may ultimately reach.

No advantage is to be obtained by generating either a single or two-phase supply in preference to a three-phase supply and there is little excuse for more than one frequency. The frequency generally used in China is 50 or 60 cycles.

Unfortunately those nations who supply China with electrical machinery have not all adopted the same frequency and the manufacturers will, when possible, recommend the frequency best suited to their own products. As development takes place in China this duplication will result in an inefficient individualistic state of the electricity supply industry, become a persistent obstacle to a comprehensive handling of the power supply problem, and make it impossible to obtain just the advantages which are peculiar to the generation and distribution of electrical energy with regard to the economy of capital, economy of coal, and other sources of power. With regard to the voltage for detail distribution for lighting and heating apparatus, for domestic purposes, it is suggested that only one, or at the most two, values are sufficient.

For purposes of generation, 11,000 volts is the maximum safe pressure. Under certain conditions, it is very difficult to show that any main distribution pressure below 50,000 volts is more economical than 11,000 volts owing to step-up transformers not being necessary, which extends the use of this pressure in an exceptional degree. When step-up transformers are necessary, a lower generation pressure, from 5,000 to 6,600 volts, would be more economical, but it is quite unnecessary to adopt various values in different parts of the country.

The difficulties of applying any form of standardisation in China are admittedly great, but if through some centralised body representatives of manufacturers who supply electrical plant and apparatus and those connected with the distribution of electricity alike can be persuaded to accept agreed standards, the interests of the industry as a whole will be served and a high average efficiency secured. Satisfactory standardisation is not arrived at by any section of the community imposing its opinions on others, but rather is the result of co-operative action on the part of all concerned.

The natural tendency of such procedure is to raise the standard, as its reflects the consensus of opinion as to what constitutes the best practice. To ensure the best results, it is imperative that any committee appointed to deal with the matter should be representative and all who have, or could have, any interest in any proposed standardisation should give active assistance in drafting any recommendation. Such methods would register the views of the manufacturers as well as those intimately acquainted with the conditions of everyday service and would ultimately bring about a feeling of mutual confidence such as could not be realised by isolated action on the part of either, however honourable and straightforward it might be.

INSTITUTION NOTES.

Junior Institution of Engineers.—The 1923-24 session of the Institution commences on October 5th, with a meeting at the Institution Lecture Room, Victoria Street, when a lecturette upon "The Design of Underground Cable Systems" will be given by Major A. M. Taylor, M.I.E.E.

Institute of Metals.—This week the autumn meeting of the Institute has been held at Manchester; the proceedings were opened on Monday evening with a lecture by Lieut.-Col. Sir Henry Fowler, on "The Use of Non-Ferrous Metals in Engineering," and on Tuesday the Lord Mayor welcomed the delegates to the city. Numerous papers, visits to works, and social items made up an attractive programme.

Electrical Society of Glasgow.—SESSION 1923-24.—The following is the programme of meetings to be held during the session :—

Sept. 18th.—Visit to Glasgow Corporation Lighting Department.
Oct. 2nd.—Wiring of Tenement Property (open night).
Nov. 13th.—Illumination, Mr. E. J. Taylor.
Dec. 4th.—Wireless, Mr. N. Turner.
Jan. 8th.—The Electrical Trade, Mr. R. A. Ure.
Feb. 5th.—How Best to Create a Demand for Electric Service, Mr. R. Hardie.
Mar. 4th.—Registration, Mr. A. Lindsay.

Institute of Transport.—The first ordinary meeting of the 1923-24 session will be held at the Institution of Electrical Engineers, London, on October 1st, at 5.30 p.m. Sir Joseph G. Broodbank will deliver his presidential address. On October 16th Mr. Phillip Burt will lecture on "The Institute Examination Scheme."

The Electrical Power Engineers' Association.—The first lecture of the new session will be given at the Institution of Electrical Engineers, on Friday, October 5th, at 7 p.m. Mr. J. S. Atkinson, of the Powdered Fuel Plant Co., Ltd., will be the lecturer, and his subject "Development in Powdered Fuel Firing on Steam Boilers and Metallurgical Furnaces." Mr. J. H. Parker will preside. This and subsequent lectures are open to all engineers, whether members of the Association or not.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Mr. C. T. PEARCE, of Stoke-on-Trent, has been appointed shift engineer at the Eccles Corporation electricity works.

Mr. HARRY BAKER, who has been accountant and commercial assistant of the Bournemouth Corporation Tramways since the inauguration of the service in 1902, has been presented with a cheque on relinquishing the position to become secretary and manager of the Westcliff-on-Sea Motor Services, Ltd.

According to the *Railway Engineer*, Mr. GEORGE H. CROOK, signal and telegraph maintenance engineer, Victorian Government Railways, has resigned in order to accept an appointment in the Signal and Telegraph Department, Great Western Railway. Mr. Crook received his early training on the Great Western Railway, and went to Melbourne in 1912 in connection with the power signalling to be installed. He was appointed power signalling construction engineer in 1919, and shortly after his return from a private visit to England he was on March 1st, 1923, appointed maintenance engineer, signal and telegraph branch.

Mr. C. BERNARD ANGOLD, for some time with the Sterling Varnish Co. and for many years chief commercial engineer for the electrical section of the Morgan Crucible Co., Ltd., has accepted a similar position in the insulating varnish section of Messrs. Robt. Ingham, Clark & Co., Ltd., of Stratford, E.15, who have works in all parts of the world.

Sir CHARLES BRIGHT, F.R.S.E., informs us that he has withdrawn from the board of Sir Charles Bright & Partners, Ltd. His name will be retained in the title of the company for the present, but Sir Charles, himself, is no longer associated with its activities and, temporarily, his only business address is 25, Victoria Street, Westminster. Telephone : 650 Victoria.

Obituary.—DR. E. K. MUSPRATT.—We regret to record the death, on Saturday, September 1st, at Seaforth Hall, Liverpool, in his 90th year, of Dr. Edmund K. Muspratt, late chairman of the British Insulated & Helsby Cables, Ltd., and vice-chairman of the United Alkali Co. Dr. Muspratt was one of the founders of University College, now Liverpool University, of which he was one of the first two pro-Chancellors, and was elected first president of the Council.

Mr. O. H. BISHOP.—We regret to learn of the death of Mr. O. H. Bishop, A.M.I.E.E., which occurred on August 31st at Ealing, following an operation. The deceased was 18 years with the Edison & Swan United Electric Light Co., Ltd., 10 years as manager of the Birmingham branch, which he opened in 1891; and eight years as their general sales manager. Latterly he had carried on business as manufacturers' agent in London. In his various capacities he was well-known to the electrical trade.

NEW COMPANIES REGISTERED.

R. J. Lloyd & Co., Ltd. (192,244).—Private company. Registered August 31st. Capital, £300 in 5s. shares. To carry on the business of electrical and mechanical engineers, founders, smiths, machinists, manufacturers of all parts incidental to the receiving and broadcasting of wireless telegraphy and telephony, &c. The subscribers (each with one share) are :—J. Johnson, 34, Hillmarton Road, Camden Town, N.7, timber merchant; R. Lloyd, "Brent View," Highfield Road, Golder's Green, N.W.14, engineer. Qualification, £1 5s. shares. Remuneration as fixed by the company. Registered office : 332c, Goswell Road, E.C.1.

Anglo-Austrian Electric Lamp Works, Ltd. (192,237).—Private company. Registered August 31st. Capital, £1,000 in £1 shares. To carry on the business of import and export merchants and agents for the importation and exportation of electrical goods, &c. The subscribers (each with one share) are :—C. N. Springthorpe, 11, St. Mary Axe, E.C.3, merchant; B. R. Agazan, 11, St. Mary Axe, E.C.3, merchant. The first directors are not named. Solicitors : Gisborne, Woodhouse & Co., Temple Chambers, E.C.4.

Longford Insulating Co., Ltd. (192,260).—Private company. Registered September 1st. Capital, £1,500 in £1 shares. To carry on the business of manufacturers of, and dealers in wires, cables, and other articles and accessories in the electrical and allied trades, &c. The first directors are :—J. Noone, 373, Liverpool Road, Warrington, engineer; J. H. Larmuth, "Hillcrest," Upper Colwyn Bay, North Wales, engineer; J. A. Larmuth, Lightoaks Road, Claremont Estate, Irlams-o'-th'-Height, near Manchester, engineer. Qualification, £1. Registered office : Thynne Street, Warrington.

Gray Electrical Co., Ltd. (192,341).—Private company. Registered September 6th. Capital, £5,000 in £1 shares. To carry on the business of electrical, mechanical, and radio engineers, wireless specialists, &c. The first directors are :—G. Davison, 170, Hornsey Lane, N.6, music publisher; A. Gray, 41, Torrington Square, W.C.1, electrical engineer; P. E. Barratt, "Derwent," Clarence Road, Clapham Park, S.W., actor. Qualification, £100. Registered office : 110, Charing Cross Road, W.C.

Valves and Bulbs, Ltd. (192,250).—Private company. Registered August 31st. Capital, £100 in £1 shares. To carry on the business of electrical engineers and contractors, manufacturers, factors, importers and exporters of and dealers in wireless and electrical installations and apparatus, electrical and mechanical valves, lamps, horns, and hooters, rubber bulbs, and other goods, dealers in hardware, &c. The first directors are :—Mrs. L. G. Smith, "Capri," Selly Park Road, Birmingham; J. F. Smith, "Capri," Selly Park Road, Birmingham, manufacturers' agent. Qualification, one share. Remuneration as fixed by the company. Registered office : 94, Hurst Street, Birmingham.

Lissen, Ltd. (192,272).—Private company. Registered September 3rd. Capital, £3,000 in £1 shares. To take over the business of manufacturers of and dealers in wireless and other apparatus and accessories carried on by T. N. Cole and G. L. Ward at Woodger Road, Goldhawk Road, Shepherd's Bush, W., and elsewhere, as the "Lissen Co." The first directors are :—T. N. Cole, 34, Thorpebank Road, Shepherd's Bush, W.12; G. L. Ward, 222, Pennard Mansions, Goldhawk Road, Shepherd's Bush, W.12. Qualification, £1. Registered office : Woodger Road, Goldhawk Road, Shepherd's Bush, W.12.

Springfield Electric Motors, Ltd. (192,277).—Private company. Registered September 3rd. Capital, £10,000 in £1 shares (5,000 7 per cent. cumulative preference). To acquire the business carried on by S. Ellis as the "Springfield Electric Co.," to carry on the business of motor manufacturers and electrical engineers, &c., and to adopt an agreement with S. Ellis, F. W. Hobson, W. Scott, A. M. Vernon, and W. H. Shackleton. The permanent directors are :—S. Ellis, Ings Cottages, Guiseley, motor manufacturer; F. W. Hobson, "Claybanks," Guiseley, spinner. Qualification, 500 shares. Remuneration, £10 each per annum. Registered office : Ings Mill, Guiseley, Yorks.

W. B. C., Ltd. (192,279).—Private company. Registered September 3rd. Capital, £1,000 in £1 shares. To adopt an agreement with W. H. A. Terrill and to carry on the business of manufacturers of and dealers in all kinds of motor accessories and parts, electrical goods, and wireless equipment, &c. The first directors are :—R. Crook, 79, Manor Road, Richmond, Surrey, electrical engineer; W. H. A. Terrill, 35, Flanders Road, Bedford Park, W., electrical manufacturer. Qualification, £300. Remuneration as fixed by the company. Secretary : W. H. A. Terrill. Registered office : 1 and 2, Ham Yard, Piccadilly Circus, W.1.

J. A. Groome, Ltd. (192,317).—Private company. Registered September 5th. Capital, £400 in £1 shares. To acquire the business of an electrical engineer and electrician now carried on by J. A. Groome at 17, Windsor Road, and 81, High Road, Willesden Green, N.W., and to carry on the same and the business of dealers in wireless apparatus and electrical products, &c. The first directors are :—J. A. Groome, 17, Windsor Road, Willesden Green, N.W.2, electrician; S. L. Davies (managing director), 17, Windsor Road, Willesden Green, N.W.2, wireless operator. Qualification, one share. Registered office : 81, High Road, Willesden Green, N.W.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Hatcham Manufacturing Co., Ltd.—Particulars filed of £500 debentures authorised August 24th, 1923, charged on the company's property, present and future, including uncalled capital, the whole amount being now issued.

H. Haydon & Co., Ltd.—Particulars filed of £1,200 debentures authorised August 21st, 1923, charged on the company's undertaking and property, present and future, including uncalled capital, the whole amount being now issued.

Helix Heater Co., Ltd.—Mortgage debenture dated August 25th, 1923, to secure £300, charged on the company's undertaking and property, present and future, including uncalled capital. Holder : T. Taylor, 33, Handsworth Wood Road, Birmingham.

South Wales Power Co., Ltd.—Particulars filed of £750,000 debenture stock and a premium of 3 per cent. authorised May 4th, and covered by trust deed dated August 13th, 1923, constituting (a) a specific charge on £976,000 prior lien debenture stock of the South Wales Electrical Power Distribution Co., and (b) a floating charge on the company's undertaking and property, present and future, including uncalled capital, the amount of the present issue being £600,000. Trustees:—Rt. Hon. Viscount St. Davids, 7, Park Crescent, W.; and Sir Bernard Greenwell, Bart., 2, Finch Lane, E.C.

Mills, English & Co., Ltd.—Satisfaction in full on August 1st, 1923, of "B" debentures dated November 23rd, 1904, securing £2,500.

John Davis & Son (Derby), Ltd. (66,606).—Return dated July 5th, 1923. Capital, £35,000 in 20,000 ordinary and 15,000 preference shares of £1 each. 15,000 ordinary and 11,000 preference shares taken up. £26,000 paid. Mortgages and charges, nil.

Bournemouth and Poole Electricity Supply Co., Ltd. (5,189).—Return dated April 5th, 1923. Capital, £500,000 in 25,000 ordinary, 7,500 4½ per cent. preference, and 17,500 6 per cent. second preference shares, all of £10 each. 15,000 ordinary, 7,500 4½ per cent. preference, and 17,500 6 per cent. second preference shares taken up. £400,000 paid. Mortgages and charges, £187,500.

Coatbridge and Airdrie Electric Supply Co., Ltd. (89,178).—Return dated April 5th, 1923. Capital, £1,000 in £1 shares. All shares taken up. £1,000 considered as paid. Mortgages and charges, £199,812 8s. 11d.

Calcutta Tramways Co., Ltd. (14,764).—Return dated July 10th, 1923. Capital, £1,400,000 in 140,000 preference and 140,000 ordinary shares of £5 each. 50,000 preference and 137,610 ordinary shares taken up. £2 per share called up on 4,400 ordinary, £2 10s. on 8,000 ordinary, £3 10s. on 22,000 ordinary, £5 on 79,430 ordinary, and £5 on 50,000 preference shares. £732,950 paid. £185,100 considered as paid, being £5 per share on 21,700 ordinary, £3 on 4,400 ordinary, £2 10s. on 8,000 ordinary, and £1 10s. on 22,000 ordinary shares. Mortgages and charges, £350,000 4½ per cent. first debenture stock and £250,000 7 per cent. second registered debentures.

Hexham and District Electric Supply Co., Ltd. (83,869).—Return dated June 9th, 1923. Capital, £30,000 in 1,521 "A," 6,479 "B," and 22,000 "C" shares of £1 each. 1,521 "A," 6,479 "B," and 15,825 "C" shares taken up. £17,346 paid. £6,479 considered as paid. Mortgages and charges at date of return, £23,000. Debenture dated August 24th, 1923, to secure £2,000, charged on the company's undertaking and property, present and future, including uncalled capital, subject to a mortgage and debenture both dated February 24th, 1922, securing £23,000. Holder:—W. Hall, 9, Friar's Terrace, Tynemouth.

Chile Telephone Co., Ltd. (29,252).—Return dated August 8th, 1923. Capital, £50,000 in £5 shares. 99,000 shares taken up. £27,000 paid. £220,000 considered as paid. Mortgages and charges, nil.

T. W. Broadbent, Ltd. (95,420).—Return dated August 7th, 1923. Capital, £5,000 in 560 ordinary and 440 preference shares of £5 each. All shares taken up. £5,000 paid. Mortgages and charges, nil.

S. H. Heywood & Co., Ltd. (94,580).—Return dated June 23rd, 1923. Capital, £50,000 in £1 shares. 31,999 shares taken up. £4,000 paid. £27,999 considered as paid. Mortgages and charges, nil.

CITY NOTES.

Southern Brazil Electric Co., Ltd.

There was not a quorum present at the meeting of 6 per cent. mortgage debenture holders of this company, called for September 11th, so the resolutions stand over for a fortnight. The resolutions embodied a scheme whereby the net revenue of the company available for the payment of debenture interest in each of the years ending December 31st, 1923, to December 31st, 1927, inclusive, after paying necessary expenses and providing for the amount due to the Inland Revenue, be paid to the bank, to be applied in paying the interest on the debentures, accumulating at the bank until there was sufficient to pay one whole coupon. As reported in the *Financier*, Mr. E. H. Tootal (chairman of the company) said that a receivership would be against the interests of the debenture holders in view of the exchange position in Brazil. It had been stated at the meeting last year, when the reconstruction of the company was carried out, that with the milreis at 7½d. the board anticipated being able to pay their interest in full, but since then the exchange had depreciated by one-third. The fact that they could not pay the debenture interest was solely due to the depreciation of the Brazilian exchange.

German Companies.

The *Electricity Co. (late W. Lahmeyer and Co.)*, of Frankfort-on-Main, proposes to pay a dividend at the rate of 200 per cent. for 1922-23, as compared with 12 per cent. in the previous year.

The *Isaria Meter Works Co.*, of Munich, which belongs to the Brown-Boveri group, has decided to pay a dividend at the rate of 400 per cent. for 1922-23 out of net profits of 655.8 millions of marks. This result compares with 40 per cent. and 13.83 millions of marks in the previous year.

The report of *Brown, Boveri & Co.*, of Mannheim, states that the results obtained in 1922-23 could be regarded as satisfactory under existing circumstances, the net profits being 278.2 millions of marks and the dividend 150 per cent.—as contrasted with 16.2 millions and 15 per cent. in 1921-22. The working expenses, the directors say, had reached such a height as seriously to jeopardise the company's competitive capacity in the world's markets, and the high expenses had not been equalised by an increase in the efficiency of the workmen. On the other hand the measures adopted for raising the efficiency of the works had been substantially advanced, the introduction of certain machines promising to yield a fuel economy of from 25 to 30 per cent.

Mexico Tramways Co.

We reproduce the following from the City Comments in *The Times*:—"A little time ago there was a weakness in the prices of securities of the leading Mexican utility companies owing to the proposed imposition of a 10 per cent. tax upon the gross income of such companies. We now learn that Mr. E. R. Peacock, who sailed for Mexico to protest against its imposition, has telegraphed to say that 'the President has signed a decree excluding tramway companies from the 10 per cent. tax.' Such a modification of the tax was absolutely necessary, as the Mexico Tramways Co., which Mr. Peacock represents, does not earn a profit in any way equal to 10 per cent."

Stock Exchange Notices.—The undermentioned have been ordered to be officially quoted:—

Consolidated Gas, Electric Light and Power Co. of Baltimore.—$2,772,400 common stock in shares of $100 each.

Lancashire Electric Light and Power Co.—212,500 7 per cent. cumulative participating preference shares of £1 each, fully paid, Nos. 1 to 212,500.

North Metropolitan Electric Power Supply Co.—£350,000 5½ per cent. debenture stock.

Direct Spanish Telegraph Co., Ltd.—Dividend at the rate of 10 per cent. per annum on the preference shares, and an interim dividend at the rate of 8 per cent. per annum, free of tax, on the ordinary shares, both for the half-year ended June.

Adelaide Electric Supply Co., Ltd.—In order to carry out extensions and provide additional machinery, this company has decided to increase its capital from £1,500,000 to £1,750,000. —*Tenders.*

Stewart & Lloyds, Ltd.—Dividends for the past half year: at the rate of 6 per cent. per annum on the preference and 10 per cent. per annum on the preferred ordinary shares.

Sir W. G. Armstrong, Whitworth & Co., Ltd.—Interim dividend of 6d. per share (2½ per cent.) less tax, on the ordinary shares.

Dundee, Broughty Ferry and District Tramways Co.—Dividend on the ordinary shares at the rate of 7 per cent. per annum, less tax, carrying forward £623.

Western Telegraph Co., Ltd.—The directors announce a dividend of 5s. per share, making a total distribution for the year ended June 30th of 10 per cent., free of income tax.

Globe Telegraph and Trust Co., Ltd.—Quarterly interim dividend of 3s. per share on preference shares, less tax, and 5s. per share net on the ordinary shares.

Manila Electric Corporation.—Dividend of 2 per cent. for quarter ending September 30th, 1923, on common capital stock.

Mackay Companies.—Quarterly dividend of 1¾ per cent., less tax, on common stock.

British Insulated and Helsby Cables, Ltd.—Interim dividend of 1s. per share, less tax.

Eastern Telegraph Co., Ltd.—Dividend at the rate of 3½ per cent. per annum, less income tax, on the preference stock for the quarter ending September 30th, 1923, and a second quarterly interim dividend of 2½ per cent. on the ordinary stock, free of income tax, in respect of profits for the year ending December 31st, 1923.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—Interim dividend for the three months ended June 30th, 1923, of 5s. per share, free of income tax.

STOCKS AND SHARES.

TUESDAY EVENING.

THE beginning of the week found markets in a cheerful frame of mind in consequence of the more pacific developments in connection with foreign politics, added to which there was a noticeable increase in the number of people who had returned from their holidays, and who were inclined to take an interest in the Stock Exchange markets, if only in order to explore some way in which the gap of holiday expenses might be filled up. For an hour or two on Monday, a good deal of cheerfulness was exhibited round the markets. As the week developed, however, the activity fell away, and though strength of prices remained in a good many sections, it must be said that there is little increase in the general volume of business. Tokio Electric Light 6 per cent. debentures which touched 24 discount, have rallied to 7 discount, comparing with 1¼ premium at which the price stood on the eve of the receipt in London of the news concerning the earthquake. The company has suffered loss, but, according to a cable to the Whitehall Trust, its stability is unaffected, and its main sources of power supply are intact.

The cable companies are expected to do well out of the traffic which the Japanese disaster will probably bring them.

The Eastern Extension Company goes to China and Australia, so it is likely to receive a material accession of traffic for some time, in connection with earthquake news, and the business will be shared, naturally, with its associates. The Western has declared its usual dividend, making 10 per cent. for the year, and the Globe also announces its regular 10 per cent. Prices in this section are better, notwithstanding a further attack which has been launched upon the companies. In the course of the article, the yields on cable stocks and shares are set out, omitting to state, however, that the dividends on the ordinary shares of the Eastern group are paid free of tax. This makes, of course, all the difference between 5½ per cent. and 7½ per cent. The American group is steady, and other cable stocks keep firm.

The deferred Marconi meeting is expected to take place in about five weeks' time, and expectation looks forward with keen interest to the possibility of the Chairman dealing fairly extensively not only with the affairs of the Marconi company itself, but with those of the Canadian and the American subsidiaries. No doubt the Marconi board is anxious to get everything settled, as far as it can with the Government, before calling together the shareholders, though it may prove to be the case when the meeting is held that final agreement has yet to be reached with the Government in the matter of payment for war services rendered by the Marconi company.

Amongst Home Railway stocks, further sharp rises have occurred in Metropolitans and in Districts. There is no fresh reason other than that already mentioned here in both cases. Expectation looks for the Metropolitan to be taken over on the basis of a guaranteed 4 per cent. dividend by one of the bigger brethren, or, jointly, by two of them. Looking farther ahead, the buyers of Districts contend that the probabilities point to their stock being treated in the same way in years to come, and they argue that there should not be much difference between the prices of the two stocks. At present Districts stand at 54, and Metropolitans at 76, a margin of 22 points. The Metropolitan is, of course, paying the better dividend of the two, and Districts have only lately entered upon a prosperous phase, regarded from the standpoint of the stockholder who likes a return on his money. Districts are distinctly the more speculative of the pair, a fact which, to some minds, commends the stock as an advantage. Underground Electric issues keep firm, with the £10 shares in request, while there is a mild amount of speculation going on in the "A" shares, the price of which remains about 9s. 6d.

Indian issues are not influenced by the news of an earthquake in the Dependency. Business in most of these is of too limited a character to justify inclusion of their prices in a regular weekly list, but it may be of interest to mention that Calcutta Trams are 4¾, Madras preference 3¼, Rangoon preference 3¾, Cawnpore Electrics stand at 21s. 3d., Calcutta Electric Supply at 30s. 9d., and Madras Electric ordinary at 22s. 6d.

Electricity supply shares continue to show robust strength. Various shares that were quoted ex dividend last week have fully recovered the deductions. Amongst these may be mentioned Chelseas, City Lights, County ordinary and South Londons, the last-named in particular being a strong market. Rises of ¼ in Westminsters, of 1/16 in Edmundsons, and of 1/32 in Brompton ordinary show the trend of the market as a whole. There are few shares on offer; and, with the advent of Greenwich Mean Time at the end of this week, attention is more generally directed to the stocks and shares of the illumination companies.

Mexican Utility stocks are merely steady. A rise of a point in Mexico Tramway Fives is the only change to be noted, in spite of the fact that a cable has been received stating that the company is not liable for the tax of 10 per cent. which, on recent advices, it was feared might be made applicable to this undertaking. The feature amongst foreign traction issues is a jump of 6 points in British Columbia deferred, the demand being extremely persistent, and coming, so it is declared, largely from Canada. The company's preferred stock is 2 higher, and the debenture has gained a point. Anglo-Argentine Tramways retain their improvement of last week, and Brazilian Tractions are again a dollar up.

The British Insulated & Helsby Cables, Ltd., has declared an interim dividend of a shilling per share, less tax, as against 9d. per share a year ago. The price remains firm at 2 7/16. General Electric preference are 6d. better, and Siemens rose to 16s. 3d. Telegraph Constructions recovered half of their loss of £1, in sympathy with the recovery in cable descriptions. Amongst engineering shares, Babcock & Wilcox improved to 2 5/16, on vigorous buying from the North of England. The rubber share market has reacted a trifle after its recent display of strength. Evidently some of the holders regard the outlook for the raw produce as being less favourable than the optimists of a month ago had concluded; and, in the absence of a fresh influx of buyers, the improvement weakened a trifle. The iron and steel group is good, with a score or more of rises on the week, due to the impression that amongst the effects of the Japanese earthquake will certainly be a large number of contracts placed with British firms for reconstruction work. The general volume of business throughout the Stock Exchange, however, scarcely corresponds with the rises which have occurred in most of the markets, though it is expected that when the holiday season is finally over, there will be an improvement all round in Stock Exchange trade.

SHARE LIST OF ELECTRICAL COMPANIES.

HOME ELECTRICITY COMPANIES.

	Nom.	Dividend. 1921.	Dividend. 1922.	Price Sep. 11, 1923.	Rise or fall.	Yield p.c.
	£					
Brompton Ordinary	1	12	12	2⅜	+ 1/32	£5 18 3
Charing Cross Ordinary	5	9	14	11½	—	6 5 10
do. do. 4½ Pref.	5	4½	4½	4½	—	5 6 0
Chelsea	1	6	10	35/-xd	+9d.	5 14 3
City of London	1	14	15	2¾xd	+9d.	6 1 0
do. do. 6 % Pref.	1	6	6	24/-xd	+6d.	5 4 4
County of London	1	8	10	2¼xd	+6d.	4 14 1
do. do. 6 % Pref.	1	6	6	23/3xd	—	5 3 3
Edmundson's Ordinary	3	Nil	7	3⅞	+ 1/16	5 18 5
do. 6 % Pref	5	12/-	6	4¾	—	6 8 0
Kensington Ordinary	5	10	12	9½	—	6 9 9
London Electric	3	4	10	4⅜	—	6 17 6
do. do. 6 % Pref.	5	6	6	5⅜xd	—	5 11 7
Metropolitan	1	7	8½	1⅜	—	5 6 3
do. 4½ % Pref.	1	4½	4½	17/-	—	5 6 0
Newcastle-on-Tyne Ordinary	1	Nil	2½	17/-	—	2 18 10
do. 5 % Pref.	1	5	5	16/3	—	6 3 1
do. 7 % Pref.	1	7	7	23/6	—	5 19 2
Notting Hill 6 % Pref.	10	6	6	9½	—	6 6 4
North Met. Elec. 6 % Pref.	1	6	6	22/-	—	5 9 1
Urban Ordinary	1	Nil	—	15/-	—	Nil
do. 5 % Pref.	1	2½	5	⅞	—	6 17 0
St. James' and Pall Mall	5	12	14½	11⅜	—	6 9 5
South London	1	7	10	1⅛xd	+2/-	5 10 4
South Metropolitan Pref.	1	7	7	24/6	—	5 14 3
Westminster Ordinary	5	10	12	9⅜	+ ⅛	6 4 8
Whitehall Elec. Invst., 7½ % Pf.	1	7½	7½	19/9	—	7 13 10

HOME RAILS.

Central London Ord. Assented	Stock	4	4	73	—	5 9 7
Metropolitan	,,	2¼	3½	76	+1½	4 13 1
do. District	,,	1	3	54	+2½	5 11 1
Underground Electric Ordinary	10	Nil	Nil	3½	+ ⅛	Nil
do. do. "A"	1	Nil	Nil	9/6	—	Nil
do. do. Income Bonds	4	5		98	—	*5 2 0

TELEGRAPHS AND TELEPHONES.

Anglo-Am. Tel. Pref.	Stock	6	6	101½	+ ⅛	5 18 3
do. Def.	,,	1½	34/6	20⅛	—	6 9 0
Chile Telephone	5	6	6	6	—	5 0 0
Cuba Sub. Ord.	10	7	7	7½	—	9 6 8
Eastern Extension	10	10	10	17⅛	+ ⅛	5 16 9
Eastern Tel. Ord.	Stock	10	10	174½	+1	5 14 7
Globe Tel. and T. Ord.	10	10	10	17⅜	+ ⅛	5 15 1
do. do. Pref.	10	6	6	11¼	—	5 6 6
Great Northern Tel.	10	24	23	27½	—	8 1 6
Indo-European	25	10	7	33½	—1	5 7 8
Marconi	1	25	15	2⅞	—	6 9 10
Oriental Telephone Ord.	1	12	12	1½	—	*6 8 9
United R. Plate Tel.	5	8	8	6½	—	*6 8 1
West India and Panama	10	Nil	Nil	1/6	—	Nil
Western Telegraph	10	10	10	17⅛	+ ⅛	*5 16 9

HOME AND FOREIGN TRAMS, &C.

Anglo-Arg. Trams. First Pref.	5	5½	12½	3	—	9 3 4
do. do. 2nd Pref.	5	Nil	5½	2⅛	—	11 17 10
do. do. 5% Deb.	Stock	5	5	73½	—	6 18 0
British Electric Traction Ord.	,,	4½	5	73½	—	6 16 1
do. do. 6 % Pref.	,,	6	6	100½	—	5 19 3
Brazil Tractions	100	Nil	4	47	+1	8 10 2
Brit. Columbia Elec. Rly. Pce.	Stock	5	5	86½	—	5 15 7
do. do. Preferred	,,	5	96/-	81½	+2	*5 18 0
do. do. Deferred	,,	8	127/-	95½	+6	*6 14 2
do. do. Deb.	,,	4½	4½	81½	+1	5 4 4
Lond. & Sub. Trac. 5 % Pref.	1	3½	5	9/-	—	11 2 0
London United Tram. Deb.	Stock	4	4	60½	—1	6 12 3
Mexico Trams. 5 % Bonds	—	Nil	Nil	75	+1	6 13 4
do. 6 % Bonds	—	Nil	Nil	56½	—	Nil
Mexican Light Common	100	Nil	Nil	29	—	Nil
do. Pref.	100	Nil	Nil	56½	—	Nil
do. 1st Bonds	—	Nil	5	69½	—	7 6 0

MANUFACTURING COMPANIES.

Babcock & Wilcox	1	15	20	2⅛	—	*4 6 8
British Aluminium Ord.	1	10	5	19/3	+1/-	5 4 0
British Insulated Ord.	1	15	15	2⅞	—	6 8 0
Callenders	1	15	15	2⅜	—	6 6 4
do. 6½ Pref.	1	6½	6½	23/9	—	5 9 5
Crompton Ord.	1	10	5	⅞	—	8 17 6
Edison-Swan	1	10	Nil	5/-	—	Nil
do. do. 5% Deb.	Stock	5	5	65	—	7 13 10
Electric Construction	1	10	10	1½	—	6 16 1
English Electric	1	8	5	17/3	—	5 16 0
do. do. Pref.	1	6	6	19/6	—	6 3 0
Gen. Elec. Pref.	1	6½	6½	22/9	+6d.	5 14 5
do. Ord.	1	10	5	18/6	—	5 8 5
Henley	1	15	15	2⅞	—	6 11 7
do. 4½ Pref.	5	4½	4½	4⅜	—	5 2 10
India-Rubber	1	10	—	11/3	—	—
Met.-Vickers Pref.	2	8	8	2½	—	6 8 0
Siemens Ord.	1	10	10	½	+ 1/16	Nil
Telegraph Con.	12	20	20	24½	+ ½	*4 18 0

* Dividends paid free of Income Tax.

THE EQUIPMENT OF POWER STATION FUEL LABORATORIES.

By CHAS. F. WADE, A.M.I.Mech.E., A.M.I.E.E.

It is now admitted that no steam-driven power station, however small in capacity, can expect to get and to keep its fuel costs down to the irreducible minimum, unless the fuel itself is watched from the time it is offered for sale till the products of combustion are ultimately rejected as of no further value and the residue is committed to the ash heap. In order to keep this constant observation upon the way in which the heat of the fuel is disposed of, it is essential that some reliable testing equipment shall be available, and the nature and amount of this will be determined largely by the capacity of the plant to which it is to be applied.

Although testing for calorific values of fuels offered for sale and purchased forms an essential part of the routine of fuel control, the calorimeter value of the fuel is not by any means the be-all and end-all of fuel investigation, and, in fact, the calorific value of the fuel of itself gives but little guidance as to the suitability of different fuels for specific purposes and conditions of use. However, a reliable calorimeter is the first essential apparatus needed for the equipment of any fuel-testing laboratory, and of these instruments there are three general classes. First we have the class of calorimeter in which the fuel to be tested is intimately mixed with some solid source of oxygen; examples of this class being the simple Lewis-Thomson instrument and the Roland Wild or Parr calorimeters.

The second class of calorimeter is the low-pressure type of instrument in which the supply of oxygen in the gaseous state is drawn from an outside source and enters the combustion vessel very slightly above atmospheric pressure.

The third class of calorimeter is the high-pressure or bomb type which, in skilled hands, gives the most accurate results of any and which utilises oxygen at a high pressure for combustion of the sample. An interesting development of the bomb type of calorimeter is the Mahler-Kroeker, in which not only is the calorific value determined, but also means are provided whereby the carbon and hydrogen content of the fuel may be determined from the products of combustion in the bomb.

Although the Roland Wild calorimeter has been classed with the Lewis-Thompson, owing to the use of a solid source of oxygen blended with the sample of fuel to be tested, this is where the actual resemblance ends.

In the case of small stations where the employment of a full-time fuel specialist is not a practical proposition, a type of instrument is needed which can be readily operated by the charge engineer or other assistant who may have the necessary time available when things are running O.K. Incidentally, this addition to a charge engineer's duties will help materially in giving interest to what is often otherwise a very tedious occupation. The William Thomson class or low-pressure oxygen calorimeter offers a somewhat varied selection of apparatus from which to choose, prominent among which are the original Wm. Thomson, the Rosenhain, and the Darling, all of which are operated upon similar lines. The Darling calorimeter, however, calls for some additional, though simple, modifications beyond those supplied by the manufacturers, in order to obtain accurate results. The Rosenhain calorimeter does not call for any additional improvements beyond those embodied in the original instrument. This instrument is made by the Cambridge & Paul Instrument Co., Ltd., while the Darling is supplied by most manufacturers of chemical apparatus.

The laboratory of a large-sized undertaking will be in charge of a fuel chemist possessing sufficient skill and experience to operate a bomb calorimeter accurately, and where large amounts of fuel are concerned annually, very small variations in the quality of the fuel may account for a very appreciable gross amount. In such case the comparatively great first cost of the apparatus needed for close accuracy will be compensated for many times over in a very short space of time.

Any type of calorimeter should be fitted with electric ignition, and where the supply is a.c. a small static transformer stepping down to 8 volts at about 10 amps. will be found very convenient for this purpose. Ignition by sulphur and by other means is uncertain, and also calls for additional calculation for the heat generated by the combustion of the igniting medium itself, in the low-pressure instruments. This calculation cannot be avoided in the bomb calorimeters, as the iron ignition wire is invariably consumed.

As already mentioned in a previous article, an unsupported calorific value test may not only fail to furnish any definite information as to the practical value of the fuels under investigation, but is liable to be actually misleading. This is not only due to the failure of any calorimeter to allow for the heat which will be lost in the waste gases due to products of combustion of hydrogen, but also on account of the important effects which the amount and nature both of the ash and coke have upon the ultimate practical value of the fuel.

In the proximate analysis of coal, the first item to be determined is, of course, the moisture content, and this will be required in connection with tests made for at least two distinct purposes. First we have the analyses made in connection with the selection of fuels for purchase, and secondly there are the tests to be made for ascertaining the plant efficiency during a short trial or the losses incurred under practical working conditions.

In selecting fuels for the placing of contracts, the free moisture is not a factor which has to be taken into account, as it does not form an intrinsic portion of the fuel itself, but is highly variable and dependent upon conditions met with during transit between pit and furnace. If, however, the analysis is being made for boiler test purposes, the correct amount of free moisture present in the fuel must be ascertained with the greatest possible accuracy and calls for some additional equipment in the way of sampling appliances.

Whereas air drying without previous weighing is all that is needed in testing contract samples before proceeding to the analysis of the fuel, for the boiler test purposes we require some method of collecting the sample of coal so that the whole of its properties will be the same when tested as when it was fed into the furnace. With this object it will be necessary to provide a sufficiently large number of airtight containers each holding about 5 lb., so that half-hourly or other samples may be taken and preserved in exactly the same condition with regard to free moisture as when they were taken. The tare weight of each of the containers must be carefully ascertained and marked clearly on the container. If this method of sampling is not adopted, but a shovelful or so at intervals is merely put aside on to a heap as a sample, the result will be with wet coal that the final sample taken will be much drier than at the time the individual samples were taken, and will not therefore be representative of the fuel as fired.

The actual air drying of the coal does not call for any special apparatus beyond a large table and some means of keeping the room temperature at about 80 deg. F. for about 12 hours.

For the inherent moisture determination, a hot-air oven, preferably electrically heated, is necessary, although fairly consistent results may be obtained by drying the fuel sample on a sand bath at about 220 deg. F.

The most important of the tests included in the proxi-

mate analysis of the fuel is that for percentage volatile matter, and the usual method of heating the fuel in a closed crucible over a bunsen flame is quite unsatisfactory owing to the entire absence of any definite temperature control. As the amount of volatile matter expelled from the sample will depend upon the temperature employed, a definite means of temperature control is needed, and this is better obtained by the use of an electrically-heated furnace than in any other way. The same furnace can be used both for the volatile determination and the ash test, as the standard temperature for the volatile determination should be 900 deg. C. When it is remembered that the volatile matter expelled at 900 deg. may be as much as 30 per cent. more than that expelled at 500 deg. C., the importance of accurate temperature control in this test will be fully appreciated.

The apparatus required for the ash test calls for no special comment, except that for small quantities of samples a vertical blow lamp will be a fair substitute for the more orthodox muffle furnace.

In very small undertakings it will probably be the wisest policy to submit samples of the fuel to be investigated to some outside expert for test and analysis, by which means the investigations will be made accurately with the aid of the most reliable apparatus without the necessity for special provision in the station itself.

An essential portion of the station routine should be the continuous control testing for the determination and reduction of the losses of heat, and this cannot be deputed to an outside authority. The apparatus needed will be that which is required in order to work out a fairly accurate heat balance, and will consist of appliances for the determination of the various losses in the waste gases and also on the ash heap. This will necessitate means of ascertaining the actual percentage ash in the original fuel, the amount of hydrogen in the fuel, the composition of the waste gases, and percentage combustible in the ash heap. Of course, both the ash tests referred to (of the original fuel and the ash heap) need either a muffle or a blow lamp, as already mentioned, while in most cases the hydrogen content of the fuel can be calculated very closely from the volatile content of the fuel.

The "Orsat," or one of its modifications, is, of course, the apparatus needed for analysis of the waste gases, but unless every convenience is provided for the comfort of the operator, the "Orsat" should never be used for testing on site, but should be kept in the laboratory for use in connection with sampling bottles. For snap testing when localising sources of waste, such as those due to air leakage, the "Orsat" is quite unsuitable, and use should be made of some such portable apparatus as the "CO_2 Thermoscope" of the Underfeed Stoker Co., Ltd., this instrument giving very accurate results provided that the pump leathers are kept in good condition.

As regards the initial cost of a complete fuel-testing equipment, this may range from about £25 in the case of a small plant, using low-pressure calorimeter, sand bath, and blow lamp, &c., together with a sufficiently sensitive balance, up to about £150 for a laboratory employing bomb calorimeter and other apparatus for the most accurate determinations.

"ARRANGED FOR PANEL MOUNTING."

By "TIME-SAVER."

It is obvious, from the large number of experimental licences that have been issued, that the majority of experimental licence-holders have merely obtained their licences for the purpose of building their own "listening-in" sets. One cannot conceive that these thousands of licences represent so many thousands of research problems that are being tackled. The sets, it is true, are built as experiments, but the experiment is to see whether the set, built from instructions in a periodical or as a copy of another set owned by a friend, will work or will not. This class of experimenter is usually a good mechanic, and prides himself on making as much as possible of his set himself, giving, as a rule, particular attention to good cabinet work and finish, and producing a fine set mounted in a highly-polished wooden box with an ebonite top, all loose wires and any untidy connections being well hidden within the box. There is, of course, a limit to the parts each man will make for himself, but in nine cases out of ten he will be sure to make the box and fit the ebonite panel on it. In consequence, there is a very large demand for various parts, from cups for crystals, filament resistances, and valve holders, to transformers, variometers, and the like, and the dealers in these make a particular point that they are all manufactured "for panel mounting."

Another class of experimenter—the one for whom the experimental licence was really intended—sets out with the purpose of improving his own knowledge of wireless theory and practice, and, if possible, carrying out some new line of research or investigation. Many of these, like the writer of this article, have only limited time for this work, and whether they may possess workshops themselves or not, would grudge the time spent in making parts that they can purchase, or in executing high-class cabinet work. They wish constantly to try out different circuits, which means constantly changing connections, rearranging the positions of the various apparatus, and substituting new parts and accessories for old ones. For those who desire to work in this manner, parts "arranged for panel mounting" are a time-wasting nuisance. Such experimenters wish to work with their apparatus simply on a table or screwed to a board, and, above all, they want to have terminals and connections easily accessible; they want to connect their wires to terminals and not to be constantly soldering them to tabs and unsoldering them again when they have to be changed.

Let us take a few examples. There is, the writer believes, no good and moderately-priced filament resistance with a base that can simply be screwed to a table, and with front terminals. To use a row of filament resistances, it is necessary to mount them on the panel of a box, or to rig up some sort of bridge for them. The connections are made underneath, and in many cases they have to be soldered. The terminals of the resistances connected to the accumulator will obviously be all 'bussed together on to a common wire. Now, if a man is working, say, with a five-valve set with such a group of filament resistances and wishes to experiment with dull-emitter valves in place of ordinary valves, trying one in each stage at a time, he has to disconnect the whole of his filament resistances and make a fresh connection in a very awkward position (possibly having to solder it) each time he wants to try the dull emitter in a different stage in his set. Until recently it was impossible to obtain a valve holder for table mounting with front terminals, except at a price five or six times that of the ordinary back-connection valve for panel mounting. Recently the writer has discovered a neat and inexpensive valve holder with front terminals for table mounting at a certain retail shop, but he is living in fear of the stock being ex-

hausted or the shop being closed down when he returns for more. If a condenser, or, in fact, practically any piece of apparatus whatever, is ordered without designating that it is not for panel mounting, it involves quite a lot of work to use it on an ordinary table- or bench-connected set.

Now, the object of this article is to endeavour to induce manufacturers of parts to have some regard for the real experimenter, and to put on the market patterns which he can use, connect, and reconnect with the minimum possible trouble. The writer realises that the chief demand will continue to be for apparatus "arranged for panel mounting" for the benefit of most of those thousands of experimental licence-holders referred to, and for the many thousands more who are building sets without any licence at all. But even if the genuine experimental licence-holder is very much in the minority, and consequently not so paying a proposition from the manufacturers' point of view, his value to the cause of radio work is greater than that of the amateur mechanic, and a little trouble in meeting his demands should not be considered ill spent.

INTER-IMPERIAL TRADE—IV.

By W. G. NEWBERRY, A.M.I.E.E.

In previous articles which have appeared on this subject, reference has been made to hindrances to the sale of British goods to the Dominions resulting from British and Dominion legislation.

This article deals with handicaps of a different kind, which have particular reference to electrical goods.

Immediately after the war the British manufacturer was almost overwhelmed with advice to increase output and produce in mass. This he would have been only too glad to do, but by the time he had reorganised his factory to suit peace-time products, the demand had begun to slacken, and it was seen that a larger demand was as important as increased production.

It is here that the British manufacturer of electrical goods is at a disadvantage compared with his American and German competitors.

In the United Kingdom the use of electricity has been restricted to a small percentage of the population. In the United States and Germany much larger percentages of much larger populations use it, with the result that the American and German manufacturer can reckon on a home market of hundreds of thousands, or even millions, compared with a British home market of tens of thousands. This disability is still further accentuated by the great variety of systems of supply, voltages, and frequencies which are in use in this country.

Thus, as regards his home market, the British manufacturer can only apply the theory of mass production to a very limited degree.

No doubt the control now exercised by the Electricity Commissioners will tend to reduce the variety, and it is to be hoped that the use of electricity in this country will advance at a greatly increased pace, so that this handicap should tend to decrease, although probably it will never disappear entirely.

In the meantime, buyers should remember that every time they buy foreign goods they reduce the output of the British manufacturer and make it still more difficult for him to compete in price, for price is affected by output more than by any other factor.

Heavy general and local taxation, high cost of research and development work, heavy freights, and other incidentals tend to make "overhead" charges a much greater proportion of the total cost of production than before the war. In fact, in many articles the "overhead" charges exceed the cost of productive labour. The charges remain more or less constant whatever the output, and an increased output results in a decreased cost per article and *vice versâ*.

Faced with the necessity of a bigger market and with the absence of a big demand at home, the British manufacturer looks to the Dominions, and in a fair field there is no reason to doubt his ability to hold his own in the future as he has done in the past.

It may be noted, however, that the handicap of variety of product has still to be carried, for each country has some peculiar requirement, and in some cases, as in Canada, there is a natural tendency to standardise the foreign type.

It may be argued, of course, that the foreign manufacturer, competing in the Dominions, has to cater for the same variety; but whereas, with our chief competitors, their home demand probably exceeds their export demand, the reverse is true with many British firms, and the tendency will be for such conditions to increase. So that, whereas one may suppose that in the United States and Germany the bulk of the output is of one standard type, in this country it is divided up over a number of types, each standard in a particular country.

It is here that the benefit of the work of the British Engineering Standards Association should be felt to an increasing degree by the British manufacturer, especially if the Dominion buyers will make a practice of requiring their purchases to comply with British standard specifications.

There seems to be a regrettable tendency for Dominion engineers to draw up standard specifications for their own Dominion. Whilst it is admitted that special factors, such as climate, must be given special consideration, the writer believes that standardisation is largely settled by custom, and if, in drawing up their specifications, Dominion engineers do not follow as closely as possible the British standards, British manufacturers will lose an advantage which would otherwise be of great assistance in reducing costs of production and selling prices.

In considering the subject of mass production, one should not overlook the fact that it tends to retard progress in design. Mass production necessitates a big outlay on special machinery and tools, and, once these have been provided to suit a particular type, the manufacturer is reluctant to make any change because it may involve new tools and perhaps new machinery.

The British engineer has always suffered because he is a pioneer. Most of the epoch-making inventions have originated in this country, but in many cases foreign manufacturers have reaped greater pecuniary advantage than the British inventors because they did not enter the field until most of the pioneer work had been done and the designs had settled down to more or less standard lines.

Some critics are over-fond of urging British manufacturers to imitate the methods of their foreign competitors. One cannot help wondering whether, if he could so far overcome his characteristic independence as to become an imitator instead of an originator, he would be able to retain the position he still occupies in the world's estimation.

THE SHIPPING, ENGINEERING, AND MACHINERY EXHIBITION.

(*Continued from p. 350.*)

The Radio Communication Co., Ltd., has a directional radio equipment similar to that employed in navigation erected on its stand. The apparatus consists of a receiving framework, about 2 ft. 6 in. square, with two windings of thin wire fixed rigidly at right angles to each other, the whole being mounted on a vertical telescopic tube running in ball bearings. The connecting wires from the coil are led down the tube to a receiving cabinet, which contains a bearing indicator dial, control wheel, and radio receiving apparatus. The Robinson method, employing two aerial coils, fixed at right angles to each other, is employed. The size of one coil is such that when in the position of maximum influence it will produce by itself a signal of readable strength. The second coil is put in series with it and the signal which then results depends upon the sum or difference of the voltage produced in the coils according to the way in which the connections are made. The connections of the second coil are arranged so that they can be quickly reversed by means of a switch. In general, louder signals will be produced with one connection than with the reverse, but if the coils are turned so that the voltage in the second coil is zero no change of signal strength will result on moving the switch from one side to the other. A larger

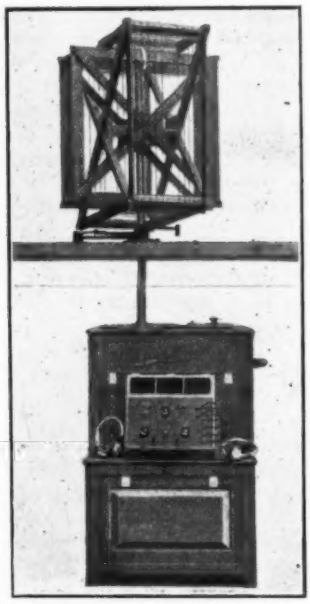


Fig. 5.—Radio Communication Co.'s Direction Finder.

difference of signal strength is thus produced as compared with the "null" or single-coil method. A typical installation, similar to that on view at the exhibition, is illustrated in fig. 5.

Several examples of transmission and reception sets for ships' use are on view. The .5-kW "Polar" spark transmitter is a very compact equipment contained in a cabinet with expanded wire top and a switchboard panel bearing the controls in front. The main and emergency motor-alternators are contained in a sound-proof compartment in the base of the cabinet, together with the synchronous spark gap. The emergency machine is mounted on top of the main alternator and is immediately put into operation by means of a change-over switch on the panel. The transmission range under normal conditions is from 400 to 500 miles. The equipment has the following dimensions: height, 5 ft. 6 in.; width, 2 ft. 2 in.; overall depth, 1 ft. 10 in. The receiver usually supplied with the set has a wave-length range of from 250 to 9,000 metres. The closed circuit is fitted with a direct reading wave-length indicator, calibrated throughout the entire wave range, enabling this circuit to be tuned instantly to any desired wave-length. The 1½-kW and ¾-kW sets shown are designed on similar lines, and the remainder of the exhibit consists of receivers for broadcasting and an automatic distress signal receiver.

The Electrical Apparatus Co., Ltd. shows, principally, motor-control equipment. The "Type R. 3" drum controller, which is one of the larger exhibits, is designed for use with 3-phase repulsion motors, or with d.c. motors. The example on view is of the protected pattern, but the controller can also be provided with a welded sheet-steel watertight case for use with ships' winches, capstans, and similar services. For use in fiery mines a similar pattern to this is supplied, fitted with "E.A.C." relief bolts. Any one of five forms of operating gear can be fitted, *viz.*, crank handle (as shown); vertical or horizontal lever handle; hand-wheel; universal lever; and rope-wheel gear. The controller is made in three standard sizes for 60 A (85 A intermittently), 77 A (105 A), and 120 A (180 A). In the d.c. design plain series control is provided in both directions. The first notches give slow speed by means of parallel resistance across the armature, and the last notches plain series control. In addition there is plain-series control in the hoisting direction, with potentiometer control in the lowering direction, and plain-series control in each direction with rheostatic braking on the first and second notches. The a.c. design can be arranged for: (*a*) 3-phase, slip-ring motor; (*b*) 2-phase, 4-wire, slip-ring motor; or (*c*) 2-phase, 3-wire, slip-ring motor. Main or shunt limit switches can be fitted.

The "Type O.R. 3" oil-immersed drum controller shown is intended for service under severe conditions, or where it is necessary to guard against explosions—as in connection with colliery haulages. The controller is built for use with a motor having a low-voltage stator and a low-current rotor. For h.p. motors single fingers are used on the stator; these are widely spaced and the rating is thereby considerably increased. The finger position is such that the maximum head of oil is obtained at the point where the current is broken. The fingers have heavy "D" section copper tips of standard size. The drum rings are also of extra heavy section, and the insulation throughout is of Bakelite, which is unaffected by hot oil. Provision is made for the release of gases to prevent explosions. In addition to these controllers the firm shows "Vauxhall" control pillars, heavy-current oil switches, house-service meters, and other instruments, &c.

Messrs. S. G. Brown, Ltd., show a complete gyro-compass equipment consisting of a master gyro-compass fitted in a binnacle, motor-generator, battery, and switchboard, together with three types of repeater compass, and an automatic course recorder for indicating deviations from a straight-line course. The gyro-compass motor runs at 14,000 r.p.m. An apparatus for transmitting orders and messages aboard ship (the "Electro-Megaphone") is exhibited. This is of compact design, enabling speech to be transmitted in two directions, the transmitter and receiver being mounted side by side. The loud-speaking receiver operates on the reed-controlled diaphragm system, and is audible even in noisy surroundings within a radius of 20 yards. To render speech audible over longer ranges a special type of receiver is provided. The "Electro-Megaphone" takes a current of 1 A at 12 V. The company also shows a few examples of its headphones for the reception of wireless telephony.

The Sunderland Forge & Engineering Co., Ltd. has four examples of lighting plant for use on board ship. The largest is a 20-kW set with an open-type, inverted-vertical, single-cylinder steam engine, directly coupled to an open-type compound d.c. generator. The output is at 100 V with the set working at 360 r.p.m. Similar sets with outputs of 5.5, 10 and 13 kW are exhibited. Two worm-geared electric winches appear on the stand. One of these is designed to raise a load of 3 tons at a speed of 45 ft. per minute. The motive power is provided by a 20-h.p., 220/230-V, d.c. motor running at 540 r.p.m. The other winch is a larger model of similar design. The remainder of the exhibit consists of a.c. and d.c. motors.

Alloy Welding Processes, Ltd., shows in operation an arc-welding plant consisting of a 10-h.p. Gardner engine driving a self-stabilising welding dynamo of the drooping characteristic type, which gives a starting current at a pressure of 70 V, which falls to the normal welding voltage immediately operations are commenced. The output is variable by the control of the field from 50 to 200 A. The set is mounted on a channel steel bedplate and totally enclosed by a rigid steel cover, leaving only the controlling gear exposed. In addition to this the company displays many examples of its special electrodes.

The Igranic Electric Co., Ltd., shows a wide range of its radio components. The exhibit comprises such articles as honeycomb duolateral tuning coils, for which a very high degree of efficiency is claimed, due to the special method of winding, audio-frequency amplifying transformers, variometers, vario couplers, filament rheostats, and battery potentiometers.

The firm also shows a new method of mounting honeycomb coils on gimbals or studs in lieu of the better-known plug type of mounting. Besides allowing the angular relation of one coil to another to be varied, this mounting also permits the coil to be rotated about its own axis, thus providing very accurate and fine tuning. The self-capacity, always an undesirable factor in tuning coils, is still further reduced, since the gimbals, which also acts as the terminals of the coil, being situated diametrically opposite one another, allow the maximum space between the in-going and the leading-out conductors. In addition there is on view a complete range of new models of coil holders, and many novel features have been introduced. One instrument shown is the "Vernob," which has been patented quite recently. This instrument consists of an ebonite

knob for attaching to variable condensers, variometers, tuning coils, and the like, by which, in addition to a movement coincident with the speed of the knob, a vernier movement may be obtained by means of an ingenious self-contained mechanism housed in the knob itself. The vernier movement enables a slow movement of approximately one-fourth of the peripheral speed of the knob to be obtained, so that both coarse and fine tuning are available whilst using only one knob. There are no gears used in the mechanism.

Hazeltine Neutrodyne Radio Sets, Ltd., is showing models of radio receiving instruments employing the well-known Hazeltine neutrodyne circuit. The essence of the arrangement is that the very considerable losses incurred in most receiving sets due to undesirable distributed capacities are eliminated or neutralised by an ingenious system of balancing capacities which compensate for inherent self-capacity in such parts as radio-frequency transformers, valves, conductors, &c. The quality of tone is also considerably enhanced, which, with the higher efficiency and consequent louder strength of signal, goes a long way in improvement of reception. The instruments are contained in a polished walnut case with a sliding glass front, and are very well made.

The Consolidated Pneumatic Tool Co., Ltd., shows, in addition to its usual display of electrically- and pneumatically-operated tool, various examples of welding plant. These are of the butt, seam, and spot welding types, and some of the plant has already been described in our pages. One seam welder is provided with a current-interrupting device, which makes the weld, in effect, a series of close spot welds. One of the principal exhibits is a combined welding and air-compressing plant mounted on a truck. It is claimed that compressed air tools are more effective for chipping or cutting material in preparation for welding, *e.g.*, scarfing or vee-ing adjacent edges. The motive power is provided by a petrol-paraffin engine, generally of 9 or 10 h.p., coupled to a 4.5-kW dynamo, and a vertical air compressor with a capacity of 42 cu. ft. of compressed air per minute. The generator is, as usual, of the "drooping characteristic" type, giving an arc-striking voltage of 60, which falls in .1 sec. to the normal welding voltage, being assisted by only a very small resistance. Another exhibit is a compact portable motor-generator operating upon d.c., suitable for tramway work. This consists of two armatures mounted upon a single shaft, with two laminated fields, in a light cast-iron case, measuring overall 32 in. long by 15 in. by 18 in., and weighing 590 lb. The set runs at 1,600 r.p.m., giving 50/150 A at 20/25 V continuously. For intermittent work as much as 200 A may be drawn from the dynamo.

The Marconi International Marine Communication Co., Ltd., has as its main exhibit a ¼-kW transmitting and receiving set for installation in a ship's lifeboat. It is claimed that the small engine with which the set is provided will permit ninety 10-minute transmissions at one-hour intervals with the consumption of only a gallon of petrol. The transmitter has a minimum range of 50 miles. The receiver is of a special direction-finding type, the single-coil or "null" method being employed. As an additional aid a powerful electric light is fitted on the top of the casing of the radio equipment, by means of which visible indication is given to other vessels of the boat's position. The compartment is fireproof and the lower part is watertight. The use of accumulators has been avoided and the filaments of the valves are supplied from dry batteries, spares being carried in hermetically-sealed cases. A duplex telephone set is shown. This is now under trial in co-operation with the General Post Office, and is intended for putting ships within a short distance of land into telephonic communication with offices ashore. A sea distance of 50 miles can be covered by the set.

Mr. W. Hamilton Wilson shows numerous examples of his high-pressure discharge apparatus. Among these is a .5-kW set with a spark frequency of 650 per second. A motor-driven interrupter is employed, which is so arranged as to break the condenser-charging current at practically zero current and is thus almost sparkless. A "building-up" action is one of the main features of the device. The interrupter is made to break when the oscillatory current is passing through its first zero, and the condenser is charged to approximately twice the voltage of the supply source owing to its having been over-charged by the energy stored inductively in the primary of the spark coil. When interruption occurs the charge in the condenser oscillates through the inductance across its terminals, so that after the end of the first half-period of the oscillatory charge the condenser becomes charged in the reverse direction. The interrupter is tuned to close the circuit for the second time when the reverse charge is a maximum. Thus, immediately the circuit is re-closed there is a voltage of approximately three times that of the supply (the condenser pressure being added to it), resulting in a greatly increased amplitude of the oscillatory current through the circuit when it is closed for the second time. The condenser discharges during the first quarter-period of the current and re-charges in the opposite direction to a still higher pressure during the second quarter-period, this direction being the same as at the end of the first "make" period. Consequently when the interrupter breaks the circuit a second time, when the supply current is again passing through zero, the condenser will be charged to a voltage which may be approximately four times that of the supply, and this building-up or resonating effect will go on increasing until a discharge begins to pass at the terminals of the secondary of the spark coil, or until the increasing losses in the system bring about a condition of equilibrium.

This transmitter is embodied in a .5-kW radio-telegraphy set suitable for small ships. The receiver of this set is designed for the reception of either spark signals or telephony; a wave-length range of from 200 to 2,600 metres is provided for.

Michell Bearings, Ltd., exhibits examples and models of its well-known products. Among these is a similar bearing to that supplied to the English Electric Co., Ltd., in connection with its Midi Railway contract. This is a 16-in. diameter journal bearing bush 14 in. in length for a large generator. It is capable of supporting 35 tons at from 500 to 900 r.p.m. Among the other exhibits are a propeller-thrust indicator operated by oil pressure, line shaft journals, thrust bearings, &c.

The Cambridge & Paul Instrument Co., Ltd., has an exhibit consisting of temperature-measuring and recording instruments, CO_2 recorders, draught and pressure gauges, &c. Most of these are already familiar to our readers, but there are one or two instruments which may not be so well known. Fig. 6 illustrates a portable "multi-point" pyrometer indicator which is useful for testing purposes, especially for checking permanently-installed instruments. The indicator

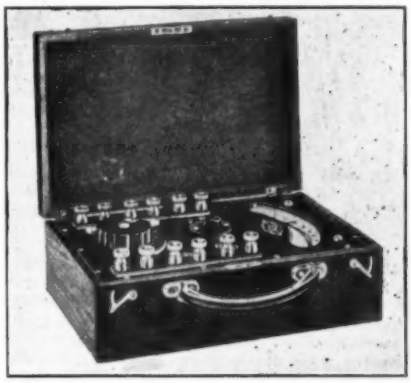


Fig. 6.—A Multipoint Portable Temperature Indicator.

consists of a moving coil galvanometer mounted with a multi-way switch in a compact travelling case. Terminals are provided which enable connection to be made to six (or fewer) thermo-couples. By moving the switch to the appropriate position the temperature corresponding to any one thermo-couple can be read on the galvanometer scale. One application of the instrument is the taking of the flue temperatures of a bank of boilers. Another handy appliance is that shown in fig. 7, which is meant for taking contact temperatures.

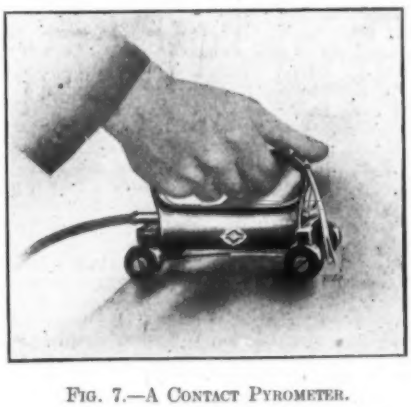


Fig. 7.—A Contact Pyrometer.

The thermo-couple is so mounted on the carriage as to touch very lightly the surface to which it is applied. It finds application in the cloth finishing, paper making, and vulcanising industries.

The Relay Automatic Telephone Co., Ltd., has upon its stand a complete example of a private telephone exchange, comprising the relay switchboard, power board, two sets of 24-V batteries, and telephone instruments, all in working order.

The Palnut Co., Ltd., exhibits numerous examples of its nut-locking device, which is made to fit micrometrically into the base of the thread to which it is applied.

(To be concluded.)

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

The Design of an Instrument Binding Post.

After a careful study of the points to be attended to in the design of a binding post for electrical instruments, the WESTINGHOUSE ELECTRIC & MANUFACTURING Co., Pittsburgh, U.S.A., has produced a binding post which is claimed to fulfil all requirements. These may be briefly summarised as follows:—It should be possible to connect a wire with one hand; the hand should be protected; the post should have a current-carrying capacity of 30 A; the coiling of strands round the screw should be guarded against; the cap should be permanently connected to the body of the post to prevent its loss; the base should not turn; it should be easy to make connection with lead clips, stiff wire, stranded wire, or flex; the wire should not be damaged in connecting it up; the post should be easily and quickly operated; it should be easy to manufacture; and it should be of neat appearance. The terminal post evolved to meet these conditions is illustrated in fig. 1. This terminal is composed of a very few simple parts as shown, making its assembly and repair very easy. Its manufacturing is relatively cheap, as nearly all the work involved is made on an automatic screw machine. The handsome bakelite cap (1) is moulded directly on the head of the screw. The small screw and lock washer (2) will not permit the complete removal of the cap, thus insuring against its loss. The base has a slot (3) provided for stiff or stranded wire and a flat surface (4) for the clips. There is no sharp corner to cut the wire and no unprotected threads in which it could get caught. Little teeth, produced by the knurl (5) and undercut (6) on the base, will bite into the instrument case, preventing the base from turning.

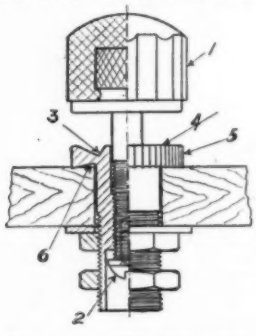


FIG. 1.—A WELL-DESIGNED INSTRUMENT BINDING POST.

An Electrical CO_2 Meter.

A CO_2 meter, made by the BACHARACH INDUSTRIAL INSTRUMENT Co., Pittsburgh, Pa., was recently described by *Chemical and Metallurgical Engineering*. This, as distinguished from the usual type, employs physical instead of chemical means. The arrangement of the meter is shown diagrammatically in fig. 2. The "tester" consists of two sets of blocks, one set containing chambers A and the other chambers B. In the centre of each chamber is a thin platinum wire, having at one end a small platinum-iridium spring for keeping the wire always central, regardless of heat expansion. A are the measuring chambers through which the flue gas passes slowly; B are the combustion chambers, containing air at room temperature. The electrical system is arranged in a Wheatstone bridge circuit, of which the four branches are the four platinum wires in the two blocks. Across the mid points of the bridge is connected the sensitive indicating galvanometer C. If desired, the recording galvanometer F, which may be placed at any reasonable distance from the measuring instrument, can also be connected into the circuit. The electrical energy is obtainable from a small storage battery G through a variable resistance J, which is adjusted to give constant current. The flue gases consist of carbon dioxide (CO_2), carbon monoxide (CO), oxygen, nitrogen and water vapour, with traces of other gases. Nitrogen, oxygen, carbon monoxide and air have all practically the same heat conductivity, but CO_2 has 40 per cent. less conductivity, and water vapour a conductivity about 30 per cent. greater than that of air. The air in the comparison chamber is kept free from water vapour by the presence of hydroscopic chemicals, and the flue gases, having passed through a cooler which also acts as a drier, contain a very small, but practically constant, quantity of water vapour, hence the only variation occurring in the heat conductivity of the gases depends entirely on the percentage of CO_2 in the flue gas.

As the electric current flows through the platinum wires, the heat generated in them is transmitted through the gases to the walls of the chambers. The gases in A, containing CO_2, transmit the heat less readily than the air in B, and the wires in A become hotter than the wires in B; its resistance therefore increases, unbalancing the circuit and causing a deflection of the galvanometer, to an extent depending on the percentage of CO_2 present. The galvanometer is calibrated to read directly in percentage of CO_2.

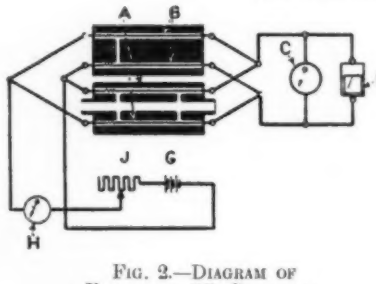


FIG. 2.—DIAGRAM OF ELECTRICAL CO_2 RECORDER.

The "Tangent" Bell Contact Pillar.

The "Tangent" patent untwistable contact pillar for electric bells is a new device now made and sold by MESSRS. GENT & Co., LTD., Faraday Works, Leicester. More electric bells go out of commission through the contact breaker twisting on its axis than from any other cause. In the "Tangent" contact pillar the same locking screw which locks the contact screw in position after adjustment also locks the contact pillar itself in the adjusted position, so as to effectively prevent it from turning on its axis, or being forced out of position by the vibration of the bell, even if its axial or central fixing screw becomes loose, as such screws often do. The illustration (fig. 3) shows (A) the contact screw, (B) the fixing screw, (C) the locking screw serving the double purpose, and (D) the slotted brass plate or strip by which the "locking" result is obtained. The strip also acts as a terminal as is usual.

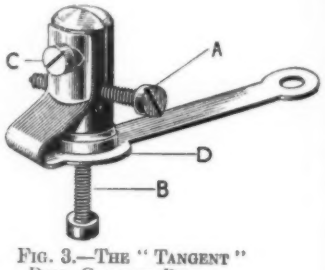
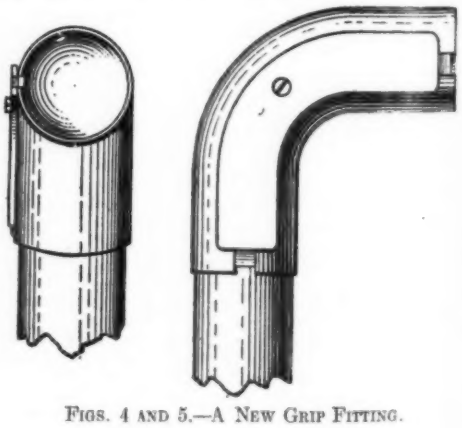


FIG. 3.—THE "TANGENT" BELL CONTACT PILLAR.

A New Grip Conduit Fitting.

It is well known that when steel conduit is used to enclose electric wiring, unless the screwed pattern is employed (and not always then), it is no easy matter to ensure that continuity of the tube, with good electrical contact at all joints is obtained. There are, of course, several types of patented grip fittings on the market which are claimed to fulfil the conditions required, but most of them involve the use of screws or screwed parts, twisting of wires, or loose parts that are liable to become detached and lost; moreover, some skill and care has to be exercised when installing them. A fitting that is claimed to overcome the above-mentioned disadvantages has recently been provisionally patented by MESSRS. HEWETT AND Co., of 315-317, High Road, Chiswick, London, W.4, and is illustrated in figs. 4 and 5, which are self-explanatory and show that the device consists of a small steel spring screwed in this case to an elbow bend. At each end of the spring is a sharp tooth, which is made to project inside the bend, so that when the conduit tube is pushed into the latter the tooth scrapes off the enamel and cuts into the metal, thus providing good contact. The device is applicable to couplings, elbows, bends, tees, &c., and is simple and inexpensve to make. Moreover, it provides a visual assurance of continuity, because the conduit tube cannot be inserted into the bend without being gripped.



FIGS. 4 AND 5.—A NEW GRIP FITTING.

REVIEWS.

Electric Lift Equipment for Modern Buildings. By RONALD GRIERSON, A.M.I.E.E., A.M.I.Mech.E. London: Chapman and Hall, Ltd. Pp. xii+179, with 96 illustrations and diagrams. Price 15s. net.

It is a remarkable fact that despite the important position occupied by the electric lift in the equipment of almost every class of modern building, the literature dealing with the design, construction, operation, and maintenance of the various forms of electric lifts is very meagre indeed. This may be due, to a very large extent, to the fact that this branch of electrical engineering has come to be regarded as rather a matter for specialists, and while this may be true as regards the design, construction, and installation of lifts, it certainly is not so as regards their operation and maintenance. The task of carrying out minor repairs to lifts falls to the lot of many electrical engineering firms, and yet it is surprising how few firms there are who willingly take on a job of that kind. It is with the object of extending the general knowledge of what is, after all, not a very complicated subject, that this book has been written, and it must be admitted that the author has succeeded admirably in his task. After a brief historical survey of the development of the electric lift—a plant of comparatively recent growth—the author deals with the subject of passenger lifts, first of all considering the requirements for an efficient lift service in a given type of building, such as a hotel or a block of offices based upon the traffic estimates, the number of lifts to be fitted, &c. The design and equipment of the passenger cars is then considered and this is followed by chapters dealing with the slinging of the car, suspension ropes and rope fastenings, balance weights, guide rails and safety gear. We come next to the methods of operating the lifts, the type of motor required for either d.c. or a.c. circuits, the electrical control gear, the magnetic and dynamic brakes, and the method of transmitting the power from the electric motor to the winding drum. Having thus considered at length what we may term the mechanical and electrical side of his subject, the author then deals with the actual building in which the lift is installed in so far as this is modified by the presence of the lift, this section of the work being concerned with the arrangement of the lift shafts, pits, gratings, landings, &c. The escalator, which may be considered as the ultra-modern form of lift, is also dealt with, this being, we should imagine, the first occasion in which the operating mechanism of the escalator has been described and illustrated in a text-book. Mention must also be made of those chapters dealing with goods and freight lifts, as these are becoming of increasing importance in the equipment of up-to-date industrial establishments, while the chapter on service lifts and dumb waiters in which the control is entirely from without, is also of very great interest. Not the least valuable part of this book is the detailed specification for an installation consisting of six passenger lifts for a modern office building, which is followed by a "checking list," whereby every item of a proposed installation is set forth so that no one detail will be omitted from the estimate. Among the other appendices mention must be made of a test sheet for an electric lift and outline of a report of the inspection of this.

It would be paying the author a poor compliment to say that this is one of the best books on the subject of electric lifts that we have seen, for, as his bibliography shows, except for the proceedings of the technical institutions (and these mostly American) the literature of this subject has hitherto been almost entirely negligible. He has, however, given us a book which, in a most admirable manner, supplies a long-felt want. The publishers, too, deserve congratulation for having produced a well-finished book at a very reasonable price. The detail drawings have been clearly reproduced, while all the half-tone illustrations are printed on art paper, so that even the smallest details come out distinctly. This is a text-book which should be in the hands of every electrical engineer, while for the architect and those engineers who may be engaged in any way in the design, construction, or maintenance of electric lifts, it should prove invaluable.

Automatic Telephone Systems. By W. AITKEN, M.I.E.E., A.Am.I.E.E. Vol. II, Auxiliary Services and Private and Branch Exchanges. Pp. xvi+227; figs. 140. London: Ernest Benn, Ltd. Price 35s. net.

In presenting the second volume of "Automatic Telephone Systems," the first volume of which was reviewed in these pages some time ago, the author apologises for the delay in its appearance by pointing to the intricate nature of the work, which necessitated the employment of specially skilled draughtsmen, and to the fact that at the time when the first volume appeared some of the more important automatic systems had not been sufficiently developed to admit of their description.

The present volume consists of 67 sections, dealing with Equipment, Party Line Working, Branch Office Services, Private Automatic Installations, Village Exchanges, Community Exchanges, &c., and each of these main divisions is in turn sub-divided to include the various types of apparatus and systems proper to these groupings.

The sections are complete in themselves, and with their associated diagrams form very compact and easily followed descriptions of modern automatic telephone practice, a fair proportion being allotted to the systems in use in the British Post Office. At the end of the volume a supplement to Volume I is added—sections 62-67 of the present volume—giving illustrated descriptions of the P.O. standard dial No. 8, the A.T.M. and A.E. Co.'s new wall and table instruments, Siemens's convertible wall and table instrument, the A.T.M. Co.'s impulse generating device, &c.

Every care has been taken to make this second volume worthy of its predecessor in every respect. The diagrams are particularly good, and in this connection the author draws attention in his preface to the unfavourable reception given to his conversion of the diagrams of different firms to the generally accepted form, as in Volume I. In the present volume he has accordingly, with one or two exceptions, refrained from making the conversions. In sections 44-45, dealing with the Siemens 100-line private exchange, and private switchboard of 200 lines capacity, he gives both forms, and leaves the reader to form his own opinion on their respective merits.

The high quality of the letterpress, and general get-up of the work which characterised the earlier volume, is fully maintained in the present one.

Practical Control of Electrical Energy. By A. G. COLLIS, A.M.I.E.E., M.Am.I.E.E. Pp. xii+160; figs. 142. Oxford Technical Publications. London: Henry Froude and Hodder and Stoughton. Price 10s. 6d. net.

A superficial examination of this book might lead the reader to suppose that he had struck an average electro-technical publication, but deeper study will show that this is not so. The reviewer has no hesitation in stating that it is quite unique—in its sheer futility. The author is evidently an enthusiast, but enthusiasm is the only virtue revealed in the work. Having put down the general impression caused by a careful perusal of the volume, it is now necessary to give a few samples of the material which gave rise to such a harsh judgment.

The preface states that the book is "intended to contain descriptive technical data of the design of electrical apparatus and machinery, as applied to everyday practice" and is "written with the object of explaining and solving alternating and direct current problems intelligently without the introduction of complicated equations and formulæ." To fulfil his purpose, the author starts off with a chapter entitled "Terms of Expression"—whatever these may be. An average sample of his efforts at explanations is as follows:—

P. 9. "Magnetic induction is the energy perceived in relation to lines of force with soft iron placed in parallel to the lines. These lines concentrate in the metal by induction. Its strength is determined by its permeability." The chapter includes an elementary "explanation" of the application of Ohm's law in direct and alternating current work. The formula given for the current flowing in an a.c. circuit in terms of the e.m.f., resistance, inductance, and frequency is wrong (p. 19). Another serious error occurs in the definition of the ampere and its relation to the C.G.S. unit of current.

Chapter II—Instruments and Systems.—This chapter is somewhat less pernicious than its predecessor. It does not, however, contain any features which might render it worth reading.

Chapter III—Protective Gear.—Most of the better known discriminative protective systems are described here in a wholly inadequate manner. The feature of the chapter to the reviewer was the paragraph on the "Author's Protective Relay." This may contain the germ of an idea which will compensate for the weakness of the rest of the book, as it has the saving grace of originality.

Chapter IV — Miscellaneous Electrical Apparatus. — The chapter does not belie its title, at least forty items being dealt with in forty-seven pages. It is of no value.

The work of the printers is excellent, and it is a great pity that their efforts were not expended on more worthy material.

Words have wholly failed the reviewer in trying to express his opinion of the utter uselessness of this book, and he feels that the proper fate of it would be the public burning of the whole edition.

Alternating Currents: Their Theory and Transmission. By E. T. LARNER. Pp. viii+198; 107 figs. London: Crosby Lockwood & Son. Price 6s. net.

This book is really a new and enlarged edition of a previous work by the same author entitled "The Principles of Alternating Currents," and one of the aims of the author, as stated in the preface, has been to produce a work to meet the requirements of the examinations of the City and Guilds of London and other tests held in the subject of alternating currents.

The matter treated in the book is almost solely concerned with the flow of single-phase alternating current in circuits, the space devoted to multiphase currents and to applications to machines being small. In view of these limitations it is a little difficult to understand what examination of the City and

Guilds the author has in mind, as there would seem to be insufficient matter to cover the old Grade II paper in alternating currents, and since this has been discontinued (as regards England), there remains only the final paper, the subject matter of which is certainly not covered by the book under notice.

The general mode of treatment is one employing little mathematics, but very extensive use is made of mechanical analogies, and the author has shown much care and ingenuity in drawing up parallels between the properties of electrical circuits and their mechanical analogues. The extent to which this process should be carried out is bound to be a matter of individual opinion, but our own feeling is that it should be employed with caution, since in many cases the time which would be spent in dealing with the preliminary mechanical case can be much better utilised in a direct attack on the electrical problem in view.

The principles of the flow of alternating currents are in general accurately stated and explained, but in a few places inaccurate ideas may perhaps be given to readers. Thus, in connection with iron-cored chokers, it is stated that so long as the iron is worked well above or well below the bend in the B-H curve, the inductance is approximately constant since the graph in these regions follows an approximately straight line. Above the bend the graph may be nearly a straight line, but its prolongation does not pass nearly through the origin, and so the inductance must vary considerably as we pass along the curve in this region. Again, in connection with a statement on page 184 concerning the earthing of the neutral point of a three-phase system, we may point out that the idea underlying the earthing is the anchoring of the potential of the system relative to earth rather than the provision of a path to earth for unbalanced currents.

A considerable number of numerical examples are included at the ends of the several chapters, and their value would be considerably increased if answers were also given.

NEW PATENTS APPLIED FOR, 1923.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. SEFTON-JONES, O'DELL AND STEPHENS, Patent Agents, 285, High Holborn, London, W.C. 1.

21,561. "Electric time switches." Gas Meter Co., Ltd., and W. E. King. August 25th.
21,569. "Telephones." Signal Ges. August 25th. (Germany, August 26th, 1922.)
21,577. "Construction and winding of inductance coils." A. T. W. Goldsmith. August 27th.
21,581. "Electric switch." W. Preston and W. Sanders & Co. August 27th.
21,582. "Electric switch." W. Preston and W. Sanders & Co. August 27th.
21,583. "Electric switch." W. Preston and W. Sanders & Co. August 27th.
21,598. "Safety switchgear for automobiles, &c." C. W. Cook. August 27th.
21,600. "Automatic earthing plug and switch." J. E. Hough, Ltd., and F. W. Pleasance. August 27th.
21,613. "Plug adaptor for mounting crystals for radio-telegraphy." H. E. Thompson. August 27th.
21,619. "Interrupters for producing high-tension discharges." W. H. Wilson. August 27th.
21,631. "Variable inductances." G. F. Mansbridge. August 27th.
21,633. "System of television." W. O. A. W. Baggally. August 27th.
21,643. "Electric signalling apparatus." J. H. Thompson. August 27th.
21,647. "Control of electric motors." Clarke, Chapman & Co., Ltd., and R. C. Harris. August 27th.
21,648. "Systems of electric distribution." British Thomson-Houston Co., Ltd. (General Electric Co.). August 27th.
21,653. "Variable inductance devices for wireless receiving apparatus, &c." A. H. Curtis and Igranic Electric Co., Ltd. August 27th.
21,657. "Illuminated displays." A. E. White (Reflecta Lens Manufacturing Co.). August 27th.
21,674. "Cables." Soc. Industrielle des Téléphones." August 27th. (France, April 28th.)
21,683. "Wireless receiving apparatus." H. L. Wood. August 28th.
21,685. "Wireless telegraph, &c., condensers." M. Anthony. August 28th.
21,686. "Terminals for electrical apparatus." D. E. Barnett. August 28th.
21,687. "Means of fitting head telephones." W. Walker. August 28th.
21,690. "Electric warning horns." Harris & Sheldon, Ltd., and T. E. Sellers. August 28th.
21,691. "Electric heating apparatus for motor-car radiators, &c." H. Hargreaves and Jackson Boilers, Ltd. August 28th.
21,703. "Electric fuses for detonators." J. H. Barker and G. I. Webb and Co., Ltd. August 28th.
21,714. "High-tension battery fuse plug." H. J. Harvey. August 28th.
21,724. "Rotors for squirrel-cage motors." Waygood-Otis, Ltd. (Otis Elevator Co.). August 28th.
21,726. "Crystal detectors for wireless signalling." W. E. Elliott. August 28th.
21,727. "Electric transmission systems." Western Electric Co., Ltd. August 28th. (United States, September 8th, 1922.)
21,740. "Energising circuit for electro-responsive devices." British Thomson-Houston Co., Ltd. (General Electric Co.). August 28th.
21,744. "Electric motor-control systems." Metropolitan-Vickers Electrical Co., Ltd., and E. Y. Robinson. August 28th.
21,745. "Protective apparatus for electric circuits." Metropolitan-Vickers Electrical Co., Ltd., and T. W. Ross. August 28th.
21,746. "Electric relays." R. N. Conwell. August 28th.
21,747. "Driving mechanism for electric locomotives." Metropolitan-Vickers Electrical Co., Ltd. August 28th. (United States, September 16th, 1922.)
21,751. "Insulated conductor for production of non-inductive cables." C. Cremer. August 28th. (Germany, December 8th, 1922.)
21,752. "Dynamo-electric machines." Akt. Ges. Brown, Boveri et Cie. August 28th. (Germany, August 28th, 1922.)
21,761. "Electrically-heated melting pots for type-casting machines." T. Bader. August 28th.
21,790. "Control of trams." A. R. Angus. August 29th.
21,798. "Method of connecting electrical apparatus." W. H. Matthews. August 29th.
21,802. "Means of reducing echo effects in telephone lines." R. M. Chamney and C. Robinson. August 29th.
21,809. "Electric switch." D. W. Dron and C. W. Redworth. August 29th.
21,814. "Electric circuit breakers." English Electric Co., Ltd., and F. Morris. August 29th.
21,831. "Clamps for connecting electric leads to overhead conductors." Rail Welding Co., Ltd. (B. J. J. Glaezel). August 29th.
21,834. "Telephonic receivers." E. A. Graham. August 29th.
21,835/7. "Loud-speaking telephones." E. A. Graham. August 29th.
21,836. "Sound-amplifying horns." E. A. Graham. August 29th.
21,838. "Tramway vehicles." Brush Electrical Engineering Co., Ltd., and W. E. Hall. August 29th.
21,839. "Variable self-induction apparatus, &c." Marrec, Ltd., and Y. Marrec. August 29th.
21,840. "Conductors for high-frequency currents." Marrec, Ltd., and Y. Marrec. August 29th.
21,841. "System for reception of constant frequency electro-magnetic waves, &c." Marrec, Ltd., and Y. Marrec. August 29th. (France, September 6th, 1922.)
21,848. "Electricity meters." F. Holden and Measurement, Ltd. August 29th.
21,878. "Variable inductances." E. Redpath. August 30th.
21,884. "Electric lighting sets for motor vehicles, &c." W. J. Nicholas and P. W. Roberts. August 30th.
21,887. "Sparking plug." A. E. Lambirth. August 30th.
21,896. "Governors for electric motors." Berkeley & Young, Ltd., and H. C. E. Jacoby. August 30th.
21,899. "Systems for varying electrical frequencies, &c." M. Compton and T. C. Gibson. August 30th.
21,900. "Microphones." Compagnie Française Thomson-Houston. August 30th. (France, August 30th, 1922.)
21,903. "Thermionic valves." H. G. Hughes and C. Seymour. August 30th.
21,910. "Electrodes." Chile Exploration Co. August 30th. (United States, March 16th.)
21,914. "Lamps for motor vehicles." W. F. M. Rose. August 30th.
21,937. "Systems of connections for rectifier plants." Akt. Ges. Brown, Boveri et Cie. August 30th. (Germany, September 1st, 1922.)
21,938. "Igniting apparatus for mercury-vapour rectifiers." Akt. Ges. Brown, Boveri et Cie. August 30th. (Germany, September 7th, 1922.)
21,941. "Tramcar and railway carriage bodies." E. S. Rayner. August 31st.
21,949. "Headpiece telephones." R. Reid. August 31st.
21,960. "Electric warning horns." Harris & Sheldon, Ltd., and T. E. Sellers. August 31st.
21,965. "Electric transformers." R. W. Strawson. August 31st.
21,969. "Electric switches." W. Preston and W. Walker. August 31st.
21,982. "Thermionic valves." B. Hodgson and C. Seymour. August 31st.

PUBLISHED SPECIFICATIONS.

The numbers in parentheses are those under which the specifications will be printed and abridged, and all subsequent proceedings will be taken.

1922.

3,436. "Means for translating vibrations." H. Baron (Signal Ges.). February 6th, 1922. (Convention date not granted.) (176,764.)
3,914. "Switch boxes connected with electric cables." L. J. Lapins. February 10th, 1922. (202,122.)
7,846. "Electric contact breakers." A. J. H. Elverson. March 17th, 1922. (202,347.)
8,965. "Electrically-driven lathes." V. R. Nicholson. January 27th, 1923. (202,351.)
10,028. "Apparatus for use in recording telephonic conversation. O. Zinke. April 8th, 1922. (202,354.)
10,513. "Rectifiers for electric currents." M. Morrison. April 12th, 1921. (178,451.)
13,647. "Portable electric lamps." R. C. Kay. May 15th, 1922. (Cognate application, 17,033/22.) (202,384.)
13,795. "Electrically-operated mining plant." J. F. Perry, A. Stubbs, and Metropolitan-Vickers Electrical Co., Ltd. May 16th, 1922. (Addition to 197,753.) (202,389.)
13,918. "Electrical testing instruments." Evershed & Vignoles, Ltd., and G. B. Rolfe. May 17th, 1922. (202,398.)
14,022. "Selecting devices for telephone systems." Siemens Bros. & Co., Ltd., E. A. Petithory, and J. E. Collyer. May 18th, 1922. (202,403.)
14,083. "Electric starting switches." E. Schattner. May 18th, 1922. (202,408.)
14,189. "Electric primers and vent-sealing tubes." V. L. Oil Processes, Ltd., O. D. Lucas, and F. G. L. Johnson. May 19th, 1922. (202,416.)
14,300. "Sound-emitting apparatus and other electrical apparatus." British Thomson-Houston Co., Ltd., and A. P. Young. May 20th, 1922. (Cognate application, 1,856/23.) (202,418.)
14,452. "Telephone circuits." T. G. Anderson and G. H. Huntsworth. May 23rd, 1922. (202,425.)
14,530. "Electromagnetically-controlled switching apparatus." Creed and Co., Ltd., and F. G. Creed. May 23rd, 1922. (202,427.)
14,718. "Control of electric motors, driving pumps, and compressors." P. Ibach. May 25th, 1921. (180,682.)
14,797. "Electric batteries." G. Weissman. May 25th, 1921. (180,685.)
14,980. "Multi-layer electric inductance coils." H. L. Thomas. May 27th, 1922. (202,438.)
15,480. "Sparking plug." W. Hedgecoe. June 1st, 1922. (202,445.)
16,478. "Automatic telephone switches." Western Electric Co., Ltd. July 21st, 1921. (183,436.)
17,910. "Construction of electric switch." G. Marr. June 29th, 1922. (202,469.)
18,933. "Arrangements for intensifying the ignition spark of magneto-ignition apparatus." Scintilla. July 23rd, 1921. (183,446.)
19,952. "Apparatus for effecting repeated closings of automatic electric switches." Akt. Ges. Brown, Boveri et Cie. September 10th, 1921. (186,036.)
20,691. "Induction motors." H. C. E. Boutard. July 29th, 1921. (183,845.)
21,353. "Electric motor-control systems." R. H. Barbour and J. M. L. Slater. August 4th, 1922. (202,509.)
22,419. "Strain insulators." British Thomson-Houston Co., Ltd. (General Electric Co.). August 17th, 1922. (202,513.)
23,125. "Electric striking and chiming apparatus controlled by an electrically-wound spring-driven device." A. G. Elam and M. Sanders. August 25th, 1922. (202,516.)
23,284. "Detectors for use in wireless telegraphy and telephony." R. M. Radio, Ltd., and H. R. Rivers-Moore. August 28th, 1922. (202,520.)
24,277. "Radiation-measuring devices." British Thomson-Houston Co., Ltd. December 31st, 1921. (190,997.)
25,451. "Means for controlling the distribution of electric power to moving picture projecting machines." E. G. Gard. September 20th, 1922. (202,537.)
25,674. "High-voltage insulator, especially suitable for electrical gas purifiers." Lodge-Cottrell, Ltd. (Metallbank und Metallurgische Ges.). September 22nd, 1922. (202,539.)
33,568. "Electrical railway game of skill." R. Herd and E. H. Pearson. December 8th, 1922. (202,573.)